Food and Agriculture Organization of the United Nations

LOSS AND DAMAGE IN AGRIFOOD SYSTEMS

ADDRESSING GAPS AND CHALLENGES

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LOSS AND DAMAGE

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Abbreviations

ADB	Asian Development Bank
AF	Adaptation Fund
AfDB	African Development Bank
AFOLU	Agriculture, Forestry and Other Land Use
AOSIS	Alliance of Small Island States
CCA	Climate Change Adaptation
COP	Conference of the Parties to the UNFCCC
CPI	Climate Policy Initiative
D&L	Damage and Loss
DRM	disaster risk management
DRR	disaster risk reduction
EWS	Early Warning System
GCF	Green Climate Fund
GDP	gross domestic product
GEF	Global Environment Facility
GHG	greenhouse gas
IAM	integrated assessment model
IOD	Indian Ocean Dipole
IPCC	Intergovernmental Panel on Climate Change
KJWA	Koronivia Joint Work on Agriculture
LDC	least developed country
LDCF	Least Developed Countries Fund
NAP	National Adaptation Plan
NDCs	nationally determined contributions
NGO	non-governmental organization
NWP	Nairobi work programme
OPYPA	Oficina de Programación y Política Agropecuaria del Ministerio de Ganadería, Agricultura y Pesca de Uruguay
PDNA	post-disaster needs assessments
SBSTA	Subsidiary Body for Scientific and Technological Advice
SCCF	Special Climate Change Fund
SIDS	Small Island Developing States
SPM	Summary for Policymakers
UNFCCC	United Nations Framework Convention on Climate Change
WFP	World Food Programme
WIM	Warsaw International Mechanism for Loss and Damage

Glossary

Attribution science	Attribution is defined as the process of evaluating the relative contributions of multiple causal factors to a change or event with an assessment of confidence (IPCC, 2022a).
Climate change adaptation	In human systems, adaptation is defined as the process of adjustment to actual or expected climate and its effects to moderate harm or take advantage of beneficial opportunities. Adaptation is subject to hard and soft limits (IPCC, 2022a).
D&L (Damage and Loss)	Refers to FAOs methodology for assessing damage and loss in the agriculture sector (including crops, livestock, fisheries and aquaculture and forestry) after an extreme event. In this methodology, "damage" is defined as "total or partial destruction of physical assets" and "loss" as "changes in economic flows arising from a disaster" (Conforti *et al.*, 2020).
Extreme weather events	An extreme weather event is an event that is rare at a particular place and time of year. Definitions of rare vary, but an extreme weather event would normally be as rare as or rarer than the 10th or 90th percentile of a probability density function estimated from observations. By definition, the characteristics of what is called extreme weather may vary from place to place in an absolute sense. When a pattern of extreme weather persists for some time, such as a season, it may be classed as an extreme climate event, especially if it yields an average or total that is itself extreme (e.g., drought or heavy rainfall over a season) (IPCC, 2018).
Limits to adaptation	The point at which an actor's objectives (or system needs) cannot be secured from intolerable risks through adaptive actions. IPCC recognizes the separation between hard and soft adaptation limits: • Hard adaptation limit - No adaptive actions are possible to avoid intolerable risks. • Soft adaptation limit - Options may exist but are currently not available to avoid intolerable risks through adaptive action (IPCC, 2018). Soft limits to adaptation can be overcome by addressing a range of constraints, primarily financial, governance, institutional and policy constraints.

L&D (Loss and Damage)	Refers to the discussions about loss and damage within the UNFCCC and the Paris Agreement. COP decision 2/CP.19 (UNFCCC, 2013): "loss and damage associated with the adverse effects of climate change includes, and in some cases involves more than, that which can be reduced by adaptation" and "establishes the Warsaw International Mechanism for Loss and Damage (WIM) […] addresses loss and damage associated with impacts of climate change, including extreme events and slow-onset events, in developing countries that are particularly vulnerable to the adverse effects of climate change" (UNFCCC, 2013). Article 8 of the Paris Agreement: "Parties recognize the importance of averting, minimizing and addressing loss and damage associated with the adverse effects of climate change, including extreme weather events and slow onset events, and the role of sustainable development in reducing the risk of loss and damage" (UNFCCC, 2015). COP decision 1/CP.21: "Article 8 of the Agreement does not involve or provide a basis for any liability or compensation" (UNFCCC, 2016).
Losses and damages	As used in the sixth assessment report of the Interngovernmental Panel on Climate Change where losses and damages refer to "adverse observed impacts and/or projected risks and can be economic and/or non-economic" (IPCC, 2022a).
Sendai Framework for Disaster Risk Reduction 2015-2030	The Sendai Framework is an international agreement endorsed by the UN General Assembly following the 2015 Third UN World Conference on Disaster Risk Reduction. The framework aims to substantially reduce disaster risks and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries.
Slow-onset events	These take place over longer time frames (typically years to decades), exerting gradual pressures that undermine the stability of a system and increase vulnerability and decrease capacity within it. Climate-related examples are sea level rise, coastal erosion, salinization, ocean acidification, temperature rise, desertification, glacial retreat and changing rainfall patterns. Droughts are usually categorized as slow-onset phenomena, but in terms of the consequences and the coping strategies adopted in response, a drought is often similar to sudden-onset events (van der Geest and Schindler, 2017).

Executive summary

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Agrifood systems are intrinsically linked to climate change and are particularly vulnerable to its impacts. Each year hundreds of billions of dollars' worth of crops and livestock production is lost due to disaster events, undermining hard-won development gains and the livelihoods of farmers. At the same time, agrifood systems are substantial contributors of emissions. As such, agrifood systems must play a central role in providing solutions for climate change – both adaptation and mitigation – while meeting the food security needs of present and future generations.

Agrifood systems and the communities that support and depend on them are also on the front lines of loss and damage associated with climate change. Loss and damage can generally be described as the negative impact of climate change that occurs despite mitigation and adaptation efforts. In other words, loss and damage represents the negative climate change impacts that could not be avoided or owing to insufficient adaptation. These residual impacts affect ecosystems, infrastructure, people's health and livelihoods all over the world. However, there is currently no internationally agreed definition for loss and damage associated with climate change.

Addressing loss and damage in the agrifood system is crucial, given its importance for livelihoods and sustainable development. In 2020, the

agrifood sector had a turnover of USD 3.6 trillion and employed 866 million people globally. The agrifood system is a vital source of income, employment and food security for millions of people around the world, especially in developing countries (FAO, 2017) and is the main source of livelihood for the vast majority of the world's poor.

Taking collective action is essential to tackle loss and damage in agrifood systems to ensure that the livelihoods of the most vulnerable communities are adequately protected and food security needs are met. Agrifood systems need to provide innovative solutions and adopt more sustainable and resilient practices that can enhance productivity, efficiency, quality and diversity of food. Despite adaptation efforts and resilience building, however, agrifood systems are expected to experience further loss and damage due to more frequent and intensified climate events.

The purpose of this report is to stimulate discussions on the central role of agrifood systems in the loss and damage debate and identify the gaps in data, knowledge and finance that need to be addressed. The report provides an overview of the loss and damage concept, the status of analytical methodologies and tools, a summary of the reporting on loss and damage in nationally determined contributions (NDCs), an outline of the policy needs and some preliminary analysis of the financing needs. The existing data is limited and should be considered part of what needs to be expanded upon to understand the loss and damage for agrifood systems in more detail.

The analysis of the NDCs finds that over 35 percent of countries' NDCs explicitly refers to "loss and damage", which is indicative of the relevance the issue is gaining among countries. Just over 33 percent of the other remaining countries broadly report on climate change negative impacts by either mentioning "loss" or "damage" as separate terms. **For those countries referring to "loss and damage," agriculture is found to be the single most impacted sector overall.**

The report shows that there is a need to further develop methodologies and tools for assessing the increasing negative impacts from climate change resulting in losses and damages. Existing methodologies often fail to capture the impacts from slow-onset events and the non-economic dimensions of loss and damage. At the same time, attribution science is becoming increasingly refined and can help develop an inventory of present-day impacts of climate change. However, not all event types are attributable to human-induced climate change and many climate change impacts are hard to evaluate. Consequently, there is a need to further develop tools and assessment methodologies that specifically capture the losses and damages from climate change impacts.

Despite definitional and knowledge gaps, **the report highlights and discusses several action areas and related measures that are relevant and can already be deployed to respond to loss and damage from an agrifood systems perspective.** While not a specific measure *per se*, the first action area highlights the need for national actors to further refine the concept of loss and damage for their local contexts, while reflecting on its relevance to national agrifood systems and the action required to protect them. Building on this first step, the report highlights areas where action should and can already be taken. These include enhancing climate and disaster risk assessment; data col-

lection and assessment requirements; implementation of disaster risk reduction and climate change adaptation measures to minimize adverse climate change impacts in agrifood systems, including through ecosystem-based solutions; anticipatory actions and early warning systems to protect the productive assets of farmers, herders and fishers before a disaster strikes based on early warning or forecasts; emergency response; and recovery, rehabilitation and reconstruction towards resilient agrifood systems.

On the financing side, there is a range of estimates of climate change financing needs for agrifood systems, however, this is not explicitly linked to loss and damage. Present levels of tracked climate finance are well below the identified potential needs for agrifood systems to address climate change, and the amount specifically required for loss and damage is difficult to quantify and, as yet, untracked. This requires specific data on the financial needs and flows for loss and damage, and the identification of financial mechanisms that will allow financial flows to target loss and damage in agrifood systems. Existing climate mechanisms and financing institutions and programmes are covering some elements of loss and damage within agrifood systems. At the same time, more resources are needed to comprehensively respond to economic and non-economic loss and damage.

The report concludes by proposing elements for a way forward. These include the need for setting out a clear working definition of loss and damage in agrifood systems, continuing to work on tools specifically for loss and damage assessments in agrifood systems, and strengthening capacity and data availability on losses and damages in agrifood systems including the data on financial needs. Overall, support to countries needs to be targeted and strengthened so that loss and damage in agrifood systems can be dealt with as early as possible. This support needs to ensure that no one is left behind while striving for better production, better nutrition, a better environment and a better life.

Kochunoi, Uganda – A Karamojong pastoralist man takes his goat cattle to graze in front of Mt. Moroto.

1 Introduction

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Agrifood systems are particularly vulnerable to the impacts of climate change. Climate change affects their capacity to produce food by altering the quality of water and soil and by adversely impacting biodiversity. Climate change not only increases the frequency and intensity of extreme weather events and causes shifts in the patterns of precipitation, but it also affects agricultural activities subject to the increasing risks of the spread of pests and diseases. These impacts can cause reduction in crop yields, livestock productivity, and fisheries and aquaculture production, ultimately leading to food insecurity, malnutrition, and poverty. Rural populations worldwide are particularly vulnerable to these effects, as they mostly depend on agriculture for their livelihoods, and have limited access to investments, infrastructure, resources and basic social services (health, education, communications, etc.). Moreover, they are faced with multiple issues involving marginalization and exclusion (FAO, 2016a; FAO, 2016b).

Agrifood systems are one of the fundamental elements contributing to a sustainable solution for food security in the future. An agrifood system is the set of activities, actors and institutions that produce, process, distribute and consume food and agricultural products (FAO, 2021a). In 2020, the agrifood sector had a turnover of USD 3.6 trillion and employed 866 million people globally. It is a vital source of income, employment and food security for millions of people around the world, especially in developing countries (FAO, 2017). At the same time, the contribution of agrifood systems to climate change is an estimated 29 percent of global greenhouse gas (GHG) emissions (FAO, 2023a).

Changes in the global climate, whether they be slow-onset changes or extreme weather events, pose a multitude of threats to agriculture and food systems all over the world (FAO, 2023e).

While we do not have exact data on impacts of loss and damage in agrifood systems, we know that losses and damages are on the increase and represent a high cost for agriculture overall. Data from post-disaster needs assessments undertaken from 2007 to 2022 shows that agricultural losses made up an average of 23 percent of the total impact of disasters across all sectors, and that over 65 percent of losses caused by droughts were experienced in the agriculture sector (FAO, 2023e). Furthermore, recent disaster statistics suggest that during the last 30 years an estimated USD 3.8 trillion worth of crops and livestock production has been lost due to disaster events, corresponding to an average loss of USD 123 billion per year, or 5 percent of annual global agricultural gross domestic product (GDP). Disasters inflicted the highest relative losses on low and lower middle-income countries, that lost an estimated 10 and 15 percent of their total agricultural GDP, respec-

tively. Small Island Developing States (SIDS) lost nearly 7 percent of their agricultural GDP (FAO, 2023e). Therefore, with climate change leading to an increase in frequency and/or intensity of weather and climate extremes, the impacts on agrifood systems are expected to be even more detrimental in the future.

The sixth assessment report of the Interngovernmental Panel on Climate Change (IPPC) provides the most recent scientific evidence surrounding the impacts of climate change on agrifood systems (IPCC, 2022a). Rising temperatures have already affected crop and grassland quality and harvest stability, and negatively impacted farmed aquatic species. Furthermore, some current global crop and livestock regions will no longer be climatically suitable for production (IPCC, 2022a). At the same time, climate-related extremes have adversely impacted the productivity of the agriculture and fisheries' sectors and led to unfavourable effects on both food security and livelihoods (IPCC, 2022a).

The IPCC report shows how limits to adaptation (that is, points where needs cannot be secured through adaptive action) have been reached, and how they are leading to losses and damages across systems, regions and sectors, including agriculture (see Figure 1). The report defines losses and damages as the adverse observed impacts and projected risks from climate change that can surpass limits to adaptation (IPCC, 2022b). Adaptation limits for agricultural production are related to water availability and the uptake and effectiveness of climate-resilient crops. As for fisheries, limits to production can be related to changes in fish distribution due to increases in sea surface temperatures or salinity. Additionally, barriers like financial resources, ineffective institutional arrangements or insufficient human capacity can make it harder to adapt and eventually lead to adaptation limits. This is the case for smallholder farmers, fishers and small-scale producers who constitute the backbone of agrifood systems and food security. At the same time, they are the most vulnerable and least able to adapt to climate impacts due to socioeconomic barriers, lack of efficient infrastructures and advanced technical expertise. Impacts are often exacerbated by weak and poorly adapted knowledge on climate-resilient practices among farmers and other value chain actors, combined with limited or non-existent access to adequate advisory services, and extension support.

The objective of this report is to reflect on what loss and damage means from an agrifood systems perspective. The report presents an overview of the loss and damage discussion, its relevance to the agrifood systems, and the current knowledge gaps and needs in the context of the debate. In addition, it makes proposals for immediate action to be taken in the areas requiring the most attention. Section 2 presents an overview of the discussion on the definition of loss and damage and outlines the differences in the terms for loss and damage and how they are applied. Moreover, it provides insight into the assessment needs and current limitations, outlines the elements of economic and non-economic impacts and approaches for their assessment, and presents some recent data extracted from the latest round of nationally determined contributions (NDC).

The analysis furthermore illustrates to what extent loss and damage in the agrifood systems has increasingly received attention at the national level. Section 3 discusses action areas and related measures relevant to responding to loss and damage that countries can implement from an agrifood systems perspective. In section 4, the financing needs for agrifood systems are

Figure 1. Loss and damage concepts and linkages

Source: Reproduced as presented in IPCC, 2022c. (Langsdorf, S., Löschke, S.,Möller, V., Okem, A., Rama, B., Belling, D., Dieck, W., et al.). Impacts, Adaptation and Vulnerability Working Group II Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. (title in italics) Chapter 10. Cambridge, UK and New York, NY, USA, Cambridge University Press.

discussed based on current data availability, including limitations and existing funding options for loss and damage. Section 5 presents the way forward and concludes by giving a broad outline of the key areas requiring attention to progress in loss and damage for agrifood systems, including improving assessment approaches; recognition at national level of this area of work; and the need for investment in agriculture.

This report further seeks to support an enhanced focus on agriculture in the current work on L&D under the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement, while drawing connections with ongoing efforts in related thematic domains in climate negotiations.

Box 1. Loss and damage in fragile states

Protracted crises have become the new norm for humanitarian actors, and new challenges are emerging. In 2022, almost 1.02 billion people lived in fragile and conflict-affected situations (World Bank, 2022). According to estimates, by 2030, fragile countries may host 60 percent of the global poor, however they will account for just 10 percent of the world's population (Corral *et al.*, 2020). These countries (where more than 70 percent of the population is dependent on agriculture-based livelihoods for employment, income and food), are also facing a stronger impact from multiple weather shocks and stresses driven by climate change. Conflicts and climate events and other crises are colliding, cascading, and compounding their negative impacts on livelihoods, food security and nutrition (IMF, 2022). Weather extreme events, together with violent conflicts and socioeconomic disturbances and other crises are the main drivers of increasing hunger. In these food crisis countries (Global Report on Food Crises, 2023), more than 70 percent of the population is facing high levels of acute food insecurity. The 2023 Global Report on Food Crises (GFRC) estimates that the number of people facing acute food insecurity rose to 258 million across 58 countries in 2022. Loss and damage in the agrifood sector can lead to particularly significant consequences when it occurs in fragile contexts marked by food insecurity, poverty, conflict and governance challenges. The recent example of five seasons of below-average rainfall in the Horn of Africa is a poignant illustration of the level of economic and non-economic loss and damages on agropastoral and pastoral livelihoods caused by drought. In addition to consecutive seasons of below-average crop production in agropastoral areas, this severe three-year drought caused the death of 13.2 million livestock across the region, which will take years for pastoralists to recover from. Furthermore, 2.7 million people have been displaced due to the drought. For these populations it will be extremely challenging to rebuild their livelihoods and return home, and many probably never will. According to the regional Food Security and Nutrition Working Group, co-led by FAO and the Intergovernmental Authority on Development, 23.5 million people faced high levels of acute food insecurity across the region due primarily to the drought, as of June 2023. Severe acute malnutrition admissions also spiked across the region and an estimated 43 000 excess deaths were reported in Somalia in 2022.

In addition to immediate humanitarian assistance to prevent food consumption gaps, treat malnutrition, and help households rebuild their livelihoods, investments in climate adaptation and resilience in agropastoral and food systems are needed in the East Africa region to reduce the impacts of future climatic shocks and stresses, which are becoming more frequent and severe. In East Africa, these urgent and priority climate actions could include, but are not limited to, prioritizing water and soil management for both human consumption and food production, such as:

- rainwater harvesting technologies, and soil and water conservation measures;
- scaling up disaster and climate risk and impact management of crop and fish production and reduction of post-harvest losses; and
- support towards the transformation of animal feed systems, given the importance of livestock production in the region.

Kabala Town, Koinadugu, Sierra Leone: Aminata Aleli Bangura, Chairlady of Sorbeh Agri-business Centre, proudly holding a couple of cabbages in the community crops near Kabala Town in Koinadugu District in Northen Sierra Leone.

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2 Loss and Damage in the Agrifood Sector

In this chapter we first review and discuss the loss and damage concept. We then provide an overview of tools, methodologies and approaches for assessing loss and damage in agrifood systems. We conclude by analysing the extent to which countries include information on L&D in their NDCs, by tracking those NDCs that specifically mention "loss and damage" and analysing the way the concept is framed in these documents.

2.1 Concepts, definitions and background

2.1.1 Loss and Damage

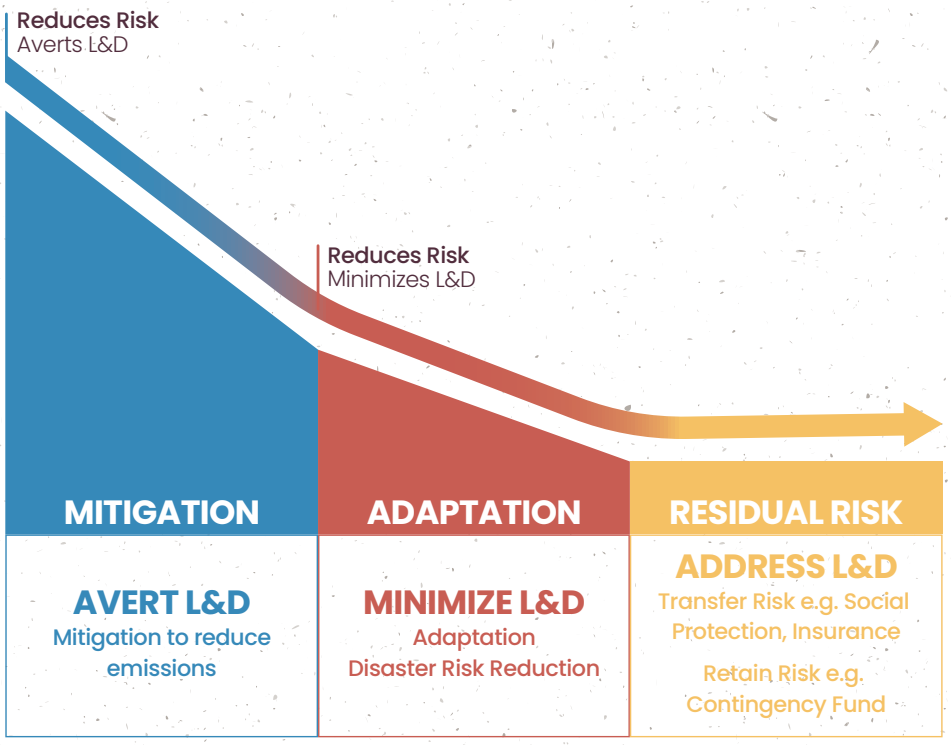
The concept of Loss and Damage (L&D) has evolved over time as a response to the growing climate crisis. L&D emerged as a key aspect of climate policy during the last decade. Originating from a proposal by the Alliance of Small Island States (AOSIS) for an insurance pool to compensate vulnerable small island and low-lying countries for the impacts of sea level rise (INC, 1991), the issue later gained support from a wider group of developing countries and was eventually institutionalized under the UNFCCC. The main vehicle to deal with L&D associated with climate change impacts under the Convention is the Warsaw International Mechanism for Loss and Damage (WIM), which was established in 2013 to advance knowledge generation, coordination and support to address L&D (UNFCCC, 2013). In the decision establishing the WIM, L&D is framed as "includ[ing], and in some cases involv[ing] more than, that which can be reduced by adaptation" (UNFCCC, 2013).

The Paris Agreement included a stand-alone article on L&D (UNFCCC, 2015). Article 8 of the Paris Agreement focuses on three types of actions that should be implemented to comprehensively respond to L&D: i) mitigation, to ensure impacts are avoided in the first place; ii) adaptation, to minimize impacts once they materialize; and iii) implementation of measures to address residual impacts. In 2019 at COP 25, the parties established the Santiago Network to catalyse technical assistance on L&D for the implementation of relevant approaches at the local, national, and regional level (UNFCCC, 2020). Finally, at COP 27 in 2022, governments took the decision to establish new funding arrangements, including a fund to assist particularly vulnerable developing countries in responding to L&D (UNFCCC, 2022). The decision recognizes the need for enhanced financial resources to respond to economic and non-economic L&D associated with the adverse effects of climate change, such as extreme weather events and slow-onset events,

especially in the context of ongoing and *ex post* (including rehabilitation, recovery and reconstruction) action (UNFCCC, 2022).

While no agreement was reached for an official definition under the UNFCCC, a growing informal consensus has emerged around the drivers of L&D, which include *extreme weather events* (e.g. heat waves, storm surges, cyclones and droughts), *slow-onset events* (e.g. sea-level rise, desertification, and rising temperatures), and the types of negative impacts that can materialize ranging from economic to non-economic losses (Figure 2). *Economic losses* refer to loss of income (e.g. agricultural production or impacts on the tourism sector) and damage to physical assets like infrastructure and property. *Non-economic losses* encompass a wide range of negative effects on individuals, the society and the environment that are difficult to quantify and monetize and that span from loss of life, impacts on health, loss of cultural heritage and territory, loss of biodiversity and ecosystem services, and issues related to climate-induced human mobility.

Figure 2. Climate change mitigation, adaptation and loss and damage



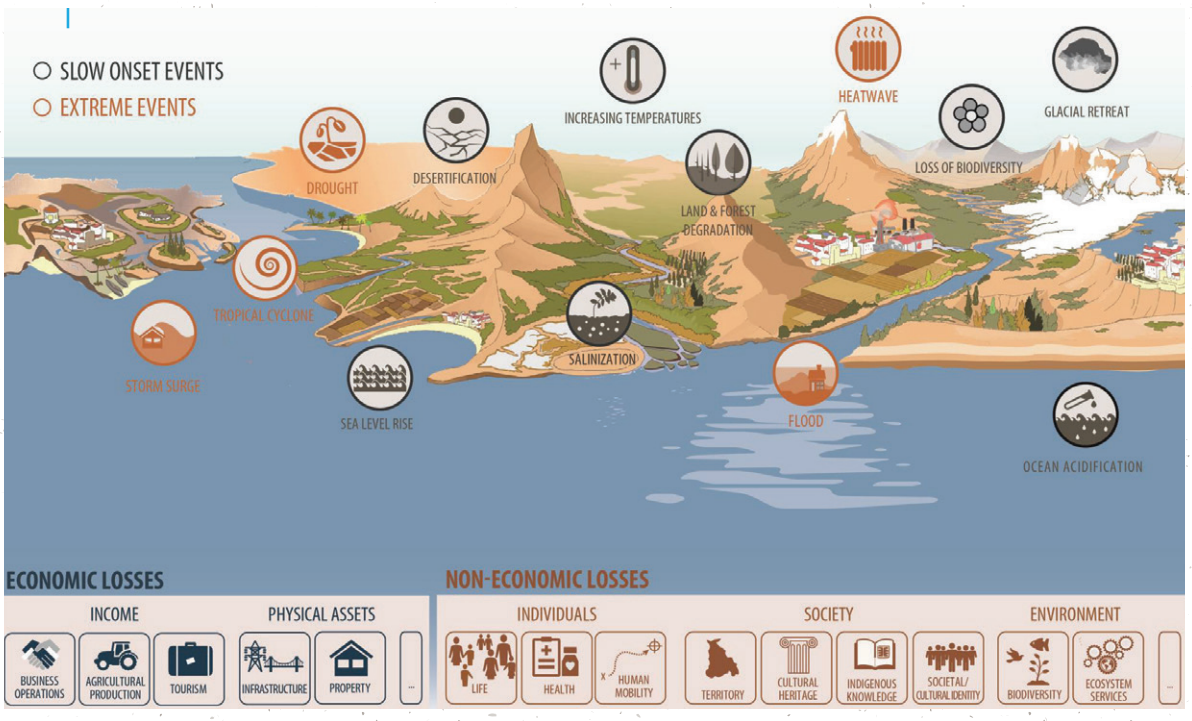
Source: Adapted from (Richards, 2022).
Richards, J.A. 2022. The Loss and Damage Collaboration. "How Does Loss and Damage Intersect with Climate Change Adaptation, DRR, and Humanitarian Assistance?" Blog post

To further clarify the meaning and definition of L&D, experts in the field have continued to explore which meanings are assigned to this concept. In a review of the academic literature, McNamara and Jackson (2018) found that L&D had predominantly been conceptualized as "limits to adaptation" and that "loss and damage is conceived as both an occurring and future condition."

The IPCC Special Report on the Impacts of Global Warming of 1.5°C above pre-industrial levels (IPCC, 2018) was the first IPCC report to engage with the concept. The report employed the distinction between "Loss and Damage" which refers to the policy debate in the UNFCCC and "losses and damages" which refers to the harm from observed impacts and projected risks (IPCC 2018). By separating L&D and losses and damages, the IPCC were able to continue scientific discussions around climate impacts resulting in losses and damages, while the policy debate could be left at the level of the UNFCCC (Hartz, 2023).

In the Summary for Policymakers, the IPCC refers to "losses and damages" as "adverse observed impacts or projected risks and can be economic and both or non-economic" (IPCC, 2022b). Key messages on "losses and damages" from the SPM include: i) recognition that adaptation cannot prevent all losses and damages, even if effective and before reaching soft and hard limits; ii) the unequal distribution of

Figure 3. Overview of climate impacts causing economic and non-economic loss and damage



Source: Reproduced as presented in UNFCC. 2018. Loss and Damage Online Guide. UNFCC. https://unfccc.int/sites/default/files/resource/Online_Guide_feb_2020.pdf

losses and damages across systems, regions and sectors; and iii) the inability of current financial, governance and institutional arrangements to comprehensively address them, particularly in vulnerable developing countries.

The Sendai Framework for Disaster Risk Reduction 2015-2030 is the institutional framework governing disasters worldwide. The Sendai Framework deals with a broad list of hazard types, however it excludes processes and human activities where it is difficult to "identify a single or limited set of hazards, compound and cascading hazards, and underlying disaster risk drivers (such as climate change)" (UNDRR, 2020). Instead, climate change, along with health, sustainable development and resilience building, are considered systemic drivers of risk within the framework (UNDRR, 2020). Drawing on the Sendai Framework's C2 indicator, FAO developed a methodology which measures the damages and losses from disasters. In this methodology, "damage" is defined as "total or partial destruction of physical assets" and "loss" as "changes in economic flows arising from a disaster" (Conforti *et al.*, 2020).

2.1.2 Agrifood systems

Agrifood systems are the complex web of activities involved in the production, processing, distribution and consumption of food and non-food agricultural products. They include the entire range of actors and their interlinked value-adding activities engaged in the primary production of food and non-food agricultural products, as well as in storage, aggregation, post-harvest handling, transportation, processing, distribution, marketing, disposal and consumption of all food products including those of non-agricultural origin. In addition agrifood systems are essential for food security, nutrition, livelihoods and environmental sustainability (FAO, 2021a). They need to provide sufficient, safe and nutritious foods for healthy diets. In addition, they should guarantee other agricultural products and services for present and future generations, leaving no one behind. This translates into inclusive climate action at the global and regional level on climate policy and governance for agrifood systems; developing the capacities for climate action at country level and scaling up climate action on the ground at the local level. Within the agrifood systems, agrifood value chains are the sequences of activities that bring agricultural products from the farm to the final consumer. Agrifood value chains can be local, national or global, depending on the demand and supply conditions. They can also be organized in different ways, such as through contracts, cooperatives or spot markets. Agrifood value chains can create value for different actors by increasing efficiency, quality, safety and sustainability of the products. Agrifood value chains are influenced by various factors, such as policies, institutions, infrastructure, technologies and innovations.

Being heavily dependent on climatic, biological, physical and chemical processes, these systems face multiple shocks and stresses. The shocks and stresses faced include climate change, extreme weather events, pest and disease upsurges, water scarcity and an overall deterioration in the natural resource base (FAO, 2021a). For example, aquaculture production is expanding however changes in the environment particularly in water temperatures and acidification is affecting the production rates. The increase of hurricanes and adverse weather conditions particularly in the tropics are destroying farm installations. The reduction of water in

Box 2. Climate change impacts on the agrifood sector in Small Pacific Island States

SIDS such as Fiji, Tonga, Vanuatu, Samoa, the Marshall Islands, and Kiribati, are grappling with severe challenges stemming from climate change. Slow-onset events such as rising temperatures, a rise in sea level, ocean acidification, land degradation, and extreme weather events like droughts, cyclones, storm surges, floods, and heatwaves, have collectively pushed these countries into a fight against significant loss and damage, particularly within their agriculture and fisheries sectors.

Severe weather events, exemplified by Cyclone Winston in Fiji and Cyclone Harold in Vanuatu, have caused significant economic losses, resulting in urgent calls to reinforce disaster preparedness and response mechanisms. These countries have set up interconnected approaches in response to climate-induced loss and damage. The establishment of more effective early warning systems and disaster management protocols has become pivotal.

Agriculture, the backbone of these economies, is bearing a considerable burden. The intensification of cyclones poses a direct threat to crop production, while the rise in sea levels amplifies the issues of salinization and coastal erosion, further endangering the sector. This hostile environment not only compromises food security but also disrupts the very livelihoods of the most vulnerable communities. To combat these challenges, countries like Kiribati and Samoa are joining efforts to fortify agricultural resilience. Innovative strategies such as agroforestry expansion, resilient ecosystem enhancement, and the cultivation of salt- and drought-tolerant crop varieties have taken centre stage.

Fisheries, another vital sector, are also at risk due to rising sea temperatures, ocean acidification, and extreme weather events. This affects fish stocks, fishing assets such as boats and gears, infrastructure such as landing sites and processing facilities, traditional livelihoods and employment, export revenues for national governments, and furthermore poses a threat to vital ecosystems and natural resources like coral reefs, mangroves and seagrass beds. Recognizing the importance of preserving marine ecosystems, Fiji and Tonga are committed to promoting sustainable fishing practices and the conservation of marine biodiversity. Additionally, safeguarding infrastructure from the ravages of storm surges and floods has emerged as a shared priority.

As they tread the path toward climate resilience, these countries are implementing measures that address a multitude of cross-cutting challenges. Coastal protection, critical for safeguarding settlements, infrastructure, and ecosystems, is a common strategy, as seen for example in the Marshall Islands. Collaborative efforts are also being made to develop financial mechanisms, such as risk-sharing and microinsurance, to face climate-related disasters in Vanuatu.

While Small Island Developing States (SIDS) shared vulnerabilities, they recognize the importance of integrated approaches that combine disaster risk reduction (DRR), ecosystem preservation, and sustainable livelihoods to effectively address loss and damage. Their strategies reflect a commitment not only to safeguarding the economy, but also to upholding traditional knowledge and ensuring the well-being of the communities who are facing an increasingly uncertain future.

certain areas is also dramatically decreasing the water level of rivers and other water bodies affecting farming practices as cage farming. A changing climate can also affect food distribution, by making roads impassable, and reducing access to ports, often resulting in food losses and increasing the cost of food in local markets.

Slow-onset events such as a rise in sea level pose a threat to coastal farming, as land disappears into the sea and salinization of land destroys the soil quality and impacts fish landing and processing. Ocean acidification further threatens the fishing industry as the acidification process creates conditions detrimental to marine life such as shellfish (NOAA, 2023). The IPCC (2022b) estimates that extreme events such as droughts, floods, heatwaves, storm surges and tropical cyclones will affect the agricultural production cycle. In addition, agriculture and food systems experience climate change impacts such as wild fires, changes in the distribution of pests and diseases and reduction of ecosystem services like pollination. These drivers cause economic losses as the stability of agricultural production is undermined, which is likely to lead to the reduction in livelihoods within the agricultural, forestry and fishery sectors globally. The increased volatility in the climate and weather system in the agrifood sector is further exacerbated by non-economic losses such as displacement of farming communities.

By their very nature, agrifood systems are highly vulnerable to the impacts of climate change due to their dependence on natural resources and weather systems. These systems are expected to experience further loss and damage due to climate change, and the people who rely on these systems will directly experience the negative impacts. Women, youth and other vulnerable groups are disproportionately affected by climate change and face significant barriers to adaptation. In fact, vulnerability to loss and damages is the most acute for people who derive their livelihoods from agrifood systems. People who rely on agrifood systems for their livelihoods disproportionately face issues of poverty, food insecurity, and limited access to services and institutions, which constrains their capacity to adapt to climate change, leading to proportionately great losses in income and wellbeing. The impacts of climate change in agrifood systems not only reduce primary productivity, but they also ripple through local economies and undermine non-farm employment and enterprises, with particularly adverse effects on vulnerable people such as seasonal agricultural labourers.

Agriculture has not been an explicit focus of L&D discussions so far. The Executive Committee of the WIM has been working on different themes including slow-onset events; non-economic losses; comprehensive risk management approaches; migration, displacement and human mobility; action and support including finance, technology and capacity-building. While some outputs of the Executive Committee and its expert groups produced under these thematic workstreams are generally relevant to agrifood systems, none of them explicitly endorses an agricultural perspective. The Santiago Network also lacks a specific focus on agriculture as it broadly aims to deliver technical assistance to particularly vulnerable, developing countries in a demand-driven way.

Agrifood systems have instead gained a specific interest in the adaptation space. In 2018 and 2019 the UNFCCC Nairobi work pro-

gramme (NWP) that deals with impacts, vulnerability, and adaptation to climate change, in other words, the UNFCCC knowledge-to-action hub for climate resilience and adaptation, was mandated to focus on agriculture and food security as one of the priority thematic areas. The NWP expert group on agriculture and food security is expected to enhance adaptation action in this area under the UNFCCC process, with particular attention to the needs of knowledge users in the least developed countries (LDCs) and SIDS. In 2022, COP 27 decided to continue the technical work initiated under the Koronivia Joint Work on Agriculture (KJWA) launched in 2017, which addresses six interrelated topics on soils, nutrient use, water, livestock, methods for assessing adaptation, and the socioeconomic and food security dimensions of climate change across the agricultural sectors. The "Sharm el-Sheikh joint work on implementation of climate action on agriculture and food security" established at COP 27 will run for four years, with the objective to implement the outcomes of the KJWA and other previous technical work addressing issues related to agriculture.

2.2 Methodologies: overview on tools, methodologies and approaches for assessing loss and damage in agrifood systems

Data for describing the impact of disasters on agriculture is partial and inconsistent, especially in the fisheries and aquaculture, and forestry subsectors (FAO, 2023e). According to the Sendai Framework Monitor, agricultural losses from disasters average USD 13 billion per year, mainly due to floods, fires and droughts (FAO, 2023e). These losses seriously affect food security and nutrition, especially for the most vulnerable groups such as smallholder farmers, pastoralists and fishers. While these impacts are not directly linked to human-induced climate change, these numbers illustrate the importance of being able to assess the losses and damages associated with climate change. Climate change disrupts the value chains, food availability and calorie intake, which may impede potential achievements in terms of food security in developing countries (Dasgupta and Robinson, 2022). Some studies have attempted to quantify impacts of climate change in countries for certain crops, for instance for crops in Sri Lanka (Amarasingha, 2021).

The lack of an agreed definition of L&D at the UNFCCC level makes it difficult to estimate and address the negative impacts of anthropogenic climate change in the agrifood sector. To assess the negative impacts from climate change, both economic and non-economic losses and damages must be accounted for.

In this section, we present a brief overview of methods that are being developed to capture and assess various aspects of losses and damages. While a full overview is beyond the scope of this report, we review some of the different types of methodologies and assess whether they measure losses and damages from an economic or non-economic perspective (or both); whether they provide an *ex ante* (prior to the occurrence of an event) or an *ex post* (after an event occurs) assessment; and finally, whether they are based on the micro (i.e. household or community) level or to a more aggregated (e.g. national) level. Another complex factor we highlight here is linked to the fact that L&D, as framed in the

UNFCCC, can be caused by either slow or extreme weather events.

The ambiguity surrounding how to define losses and damages makes it difficult to develop tools, methodologies and approaches to assess the related impacts stemming from human-induced climate change. However, in the context of a rapidly changing environment it is important to assess the ongoing and future losses and damages (Otto *et al.*, 2020). Negative climate change impacts that result in losses and damages are coupled with socioeconomic factors that alter the exposure and vulnerability of different groups (Otto *et al.*, 2020). Yet, there are to date no existing comprehensive or comparable databases that quantify the anthropogenic contribution to climate change losses and damages (Otto *et al.*, 2020; van der Geest and Schindler, 2017).

Without specifically focusing on climate change impacts, a Damage and Loss (D&L) methodology was developed that assesses disasters in agriculture. This D&L methodology is a framework for identifying, analysing and evaluating the impact of disasters on agriculture, including crops, livestock, aquaculture, fisheries and forestry (Conforti, Markova, and Tochkov, 2020; FAO, 2021c).

The D&L methodology is underpinned by several assumptions, creating challenges for assessing and addressing losses and damages as defined by the IPCC (IPCC, 2022b). Firstly, the methodology assumes that shocks to the agrifood sector are independent events and as such, their effects are not cumulative. For example, the D&L methodology assumes that annual crops are not affected in the years post disaster (Conforti, Markova, and Tochkov 2020). Secondly, the D&L methodology views damages and losses from a purely economic lens (FAO, 2021b), and overlooks the non-economic dimensions, which is a central part of framing losses and damages in the UNFCCC and the IPCC.

Box 3. Attribution and loss and damage

Experts in Loss and Damage (L&D) assessment are working on developing specific tools and methodologies to better capture the impacts specifically related to human-induced climate change. One of the methodologies that are being developed at the macro level is probabilistic event attribution. This is a rapidly evolving methodology through which it is possible to link specific extreme weather events to anthropogenic climate change (Otto *et al.*, 2020; Parker *et al.*, 2017; Verheyen, 2015). FAO together with the University of Kassel and the Potsdam Institute for Climate Impact Research are developing a methodology to quantify losses and damages associated with extreme weather events, drawing on attribution science (Undorf *et al.*, 2023). As part of this, specific cases were analysed such as soy yields in Argentina, wheat yields in Kazakstan and Morocco, and maize yields in South Africa (FAO, 2023e). The use of attribution science can help to develop an inventory of present-day impacts of climate change after the event has taken place, however, not all event types are attributable, and sector specific studies are lacking (Otto *et al.*, 2020). Similarly, challenges remain around assessing impacts of slow onset events, as the consequences of these kinds of climate change impacts do not appear to have a clear "beginning" or "end."

An additional methodology often used at the macro-level and after a disaster event has occurred, i.e. with an *ex post* lens, is the post-disaster needs assessments (PDNA). This methodology offers a comprehensive approach where government and non-governmental organizations (NGO) collaborate to assess the humanitarian needs for those affected, assess the losses and damages caused by the disaster, as well as enable the development of a recovery plan (GFDRR, 2013). However, losses and damages are not only a result of climate impacts that manifest through extreme weather events such as cyclones but are also the result of slow-onset events, such as desertification. As slow-onset events do not necessarily have a start or end date, it is not clear how PDNA might apply in such contexts. There is therefore a greater need to better understand how PDNA can consider climate change losses and damages, and specifically losses and damages from slow-onset events.

For macro-level analysis, integrated assessment models (IAMs) can be used. These models allow to jointly address the economic and natural processes related to climate change. IAMs are built with the objective to model alternative future climate change scenarios. This allows for including different types of climate policies and for accounting for some of the complexity of the functioning and relationships across biogeochemical and socioeconomic components of the earth system (Weyant, 2017).

IAMs can therefore be an important tool for supporting climate policy making, as they also account for the effect of modelled climate trajectories on the economic system (Bosetti, 2021). In the L&D context, these models could be useful for an aggregated estimation of losses and damages from climate change beyond adaptation expenditures and efforts (Markandya and Gonzalez-Eguino, 2018). IAMs adopt an *ex ante* perspective, although their calibration can also be based on *ex post* empirical exercises that can provide, for example, benchmarks for policy effectiveness and key parameter estimates to calibrate *ex ante* analytical models (Pisu *et al.*, 2023). IAMs are extremely sensitive to modelling choices with limitations due to the level of uncertainty *vis-à-vis* future damages. In addition, country level differences and heterogeneity in agricultural sectors may be significant in the modelling effort as well as in the interpretation of results. With a more specific focus on the agri-food sector, the use of IAMs is a promising option for modelling the future evolution of agricultural systems depending on changes in socioeconomic development, technology, and climate conditions. This requires, however, the development of robust representations of responses of the agricultural system, as well as better data availability (Ruane *et al.*, 2017; Farrell *et al.*, 2023).

The highlighted methodologies mainly focus on the monetary valuation of losses and damages. However, the need to better address slow-onset events and to capture the specificities of losses and damages at a more micro level, is coupled with the need to improve our ability to capture non-economic dimensions of loss and damage. Some organizations have developed their own assessment methodologies to assess losses and damages in vulnerable or rural communities (Anderson, Hossain and Singh, 2019; van der Geest and Schindler, 2017) as well as in the tourism and agriculture sectors (Iese *et al.,* 2022). These methodologies often take a community-based approach, which frequently includes participatory

Box 4. Losses and damages assessment in Uruguay

The National Climate Change Policy of Uruguay has established, as a priority, the strengthening of climate-related disaster risk management (DRM) at the national, regional, and local levels to reduce vulnerability to climate change and climate variability. For this reason, strengthening the comprehensive emergency and DRM is an integral part of Uruguay's nationally determined contributions (NDC) to the Paris Agreement. In its second NDC, Uruguay aims to implement measures by 2030 to enhance the processes for recording, measuring, and assessing the impacts of climate-related adverse events to estimate losses and damages at the national, local, and sectoral levels. Uruguay's Second Adaptation Communication to the United Nations Framework Convention on Climate Change (UNFCCC) also prioritizes the implementation of adaptation measures to address the impacts of climate change and climatic variability on socioecological systems and reduce damage and loss. In this regard, the development of mechanisms and procedures to improve the recording, storage, estimation, and visualization of losses and damages at the national, local, and sectoral levels is crucial.

According to the national accounts statistics, agriculture, livestock, forestry and fisheries accounted for, on average, 8.6 percent of Uruguay's gross domestic product (GDP) in 2017–2021. If the related manufacturing industries (food, wood, cellulose, leather and wool) are added to the above, this percentage increases to 19.7 percent on average, in the same period. Other related activities, such as transport, logistics, and commerce are not considered in the calculation because it is impossible to disaggregate the statistics. In addition, agro-industrial chains have a significant relevance in Uruguay's external insertion, since they contribute around 80 percent of the value exported.

Drought is perceived by the productive sector as the most significant risk. In the last 15 years, eight water deficit events generated, on average, direct losses equivalent to 1 percent of the country's value added. The 2022/2023 water deficit alone generated direct losses equivalent to 3 percent of the GDP.

Since 2017, the Oficina de Programación y Política Agropecuaria del Ministerio de Ganadería, Agricultura y Pesca de Uruguay (OPYPA) has worked on a system for assessing losses and damages due to climatic events for the agricultural sector (e.g. Proyecto "Apoyando a los países menos desarrollados y países en desarrollo en la integración de los sectores agrícolas en los Planes Nacionales de Adaptación financiado por FAO y PNUD") with the support of FAO (ECLAC methodology adapted by FAO was implemented), in the case of agriculture and livestock production (meat and milk). The Instituto Nacional de la Leche and the Instituto Nacional de Viticultura have collaborated in dairy and viticulture losses and damages estimates. Uruguay shared his experience to other countries in the region, through the Consejo Agropecuario del Sur.

At the national level, in 2016 the Change Response System set up a working group to design a loss and damage evaluation. Since 2021, the National Emergency System has adapted and implemented the existing damage and loss methodologies (post disaster needs assessments and damages and losses assessment) in the activity sectors. In 2022, Uruguay established the obligation to report all losses and damages. As a result, for the first time OPYPA and Sinae reported the agricultural losses and damages to the Sendai

Framework Monitor (UNDRR, 2022). One of the main challenges has been the integration of the information systems of relevant actors. It has attempted to implement automated calculations at country level, but this was possible for only some of the information systems, due to the different levels of technological advancement of the institutions involved. Among the main challenges is the possibility of generating estimates with greater geographical disaggregation, for example, to delimit areas by risk type and exposure levels.

On the other hand, it could be useful to integrate information from the private sector (producer organizations, insurers) to improve estimates.

The strength of the approach and system, builds on a long-standing tradition and basis of official data collection on production and monitoring of agroclimatic data in the country, and the existence of an integrated network of institutions linked to the agricultural sector, which can provide validated information, allowing this process to take place.

elements such as a participatory rural appraisal, participatory evaluation techniques (van der Geest and Schindler, 2017), participatory action research, where participants can for example map out their remembered and experienced climate stressors (Iese *et al.,* 2022), and risk and resource mapping (Anderson, Hossain and Singh, 2019). Some of the challenges associated with these methodologies relate to the possibility of upscaling the methodology (van der Geest and Schindler, 2017) and how to decouple the impacts of human-induced climate change with wider socioeconomic vulnerabilities of a community.

Microanalysis can also be based on data collection through surveys, focus groups and interviews. These methodologies can help provide information on: i) areas where insufficient measures have been adopted; ii) costs borne to adopt measures that cannot be recovered (especially those that are more intangible); iii) measures adopted that cope with problems in the short term but have potential long-term negative impacts; or finally iv) the cases where measures have not been adopted at all (Warner and Van der Geest, 2013).

These limitations may arise due to the existing constraints on adopting measures (such as knowledge, financial availability etc.) or to technical or physical limits. The intangible nature of costs that cannot be "regained" is particularly important when focusing on local communities and households and clearly links to non-economic losses and damages. For example, Nand *et al.* (2023) assesses the loss and damages from cyclones in the sugarcane farming communities in Fiji. Using semi-structured interviews with farmers and other relevant stakeholders, the authors were able to specifically identify relevant non-economic losses and damages.

Due to the difficulties encountered when measuring and quantifying non-economic losses and given that they are considered intangible, Menk *et al.* (2022) argue that efforts to systematically assess non-economic losses and damages have been neglected. Menk *et al.* (2022) propose the possibility of adapting the "impact chain method," which is a framework designed for climate change risk and vulnerability assessment. The authors state that this method can untangle complex

risks in socioecological systems by combining stakeholders and performing quantitative data analysis. Chandra *et al.* (2023) focus on the identification of issues related to policy on non-economic L&D, based on responses to surveys administered online to stakeholders featuring a direct involvement with parties affected by non-economic losses and damages in the context of the Pacific Islands. The critical issues and challenges identified include knowledge, data and science, financial resources availability, low stakeholder awareness and the inability to deal with relevant dimensions of non-economic losses and damages. Boafo *et al.* (2023) use the works by Tschakert, Tutu and Alcaro (2013) as a basis to construct a qualitative approach to assessing non-economic impacts on farmers. The authors used a purposeful sampling technique in a specific farming area to map out the farmers understanding and experience of climate change, as well as the impacts they were suffering from, such as loss of social cohesion and indigenous knowledge as well as resources. However, the possibility of scaling up such methods presents several challenges, as values are inherently subjective and can vary significantly in different contexts.

All the highlighted methods, together with the attempt to provide discussions on potential limitations, show that several knowledge gaps remain. This is particularly true with reference to the agricultural impacts. For example, a recently conducted assessment found that crop failures are one of the key areas of losses within the agricultural sector (Challinor *et al.,* 2014). However, losses and damages in the agrifood sector are also caused by stresses from other living organisms such as weeds, insects, and other animals, fungal, bacterial, and viral disease, as well as abiotic stress related to water availability, temperature, soil health and wind strengths (Balzter *et al.,* 2023). As such, the remaining knowledge gaps include how to better adapt existing losses and damages assessments to the agrifood sector. Again, this clearly demonstrates the need for increased attention to slow-onset events.

The uncertainty surrounding the assessment of L&D is well described in the analysis developed by Bouwer (2019), who stresses that several types of non-monetary impacts are underestimated, making the assessment of L&D more complex. Bouwer (2019) also underlines the fact that residual losses (that is, losses after accounting for risk reduction and adaptation) from extreme weather have not yet been attributed to anthropogenic climate change. This is linked to the complexity of the task of attributing climate-related losses to human activities and related GHG emissions.

2.3 Loss and Damage in Agrifood Systems as Reported in Countries' NDCs

NDCs outline countries' national efforts to reduce emissions and adapt to the impacts of climate change. They also increasingly include considerations about the losses and damages suffered at the national level and the responses countries are starting to devise and undertake to confront them (Calliari and Ryder, 2023). This section analyses the way L&D is framed in countries' NDCs from an agrifood systems perspective. It first provides an overview of the extent to which countries include information on L&D in their NDCs, by tracking those NDCs that specifically mention "loss and damage" (and not just "loss" and/or "damage" separately) and analysing how this differs

from regional to income groups. It then pays particular attention to the type of L&D, which has been reported and distinguishes between economic and non-economic losses, whether these are driven by extreme or slow-onset events, and the specific sectors they refer to.

Overview of reporting on loss and damage in NDCs

All active NDCs published as of 30 June 2023 were downloaded and reviewed to retrieve information on L&D at the country level and analyse how specific mentions of L&D referred to the agrifood systems. A total of 168 countries constitutes the set of data developed (countries belonging to the European Union represent one reporting group, given that countries in the European Union report one single NDC). The NDCs were screened for all references to i) "loss," "damage" and "loss and damage" (singular and plural); ii) the sector in which loss and damage was reported and whether explicit reference was made for example, to crops, livestock, etc; iii) the loss and damage type, such as economic or non-economic; and iv) the type of hazard driving loss and damage (slow onset event or extreme weather event).

With respect to L&D references, countries were grouped into three categories. "L&D Countries," category A, which encompasses all countries that explicitly included the mention of the phrase "loss and damage" (singular and plural) in their NDC (see Table 1). "Other mention" countries, category B, contains all countries that included a reference to climate change negative impacts by mentioning "loss" and "damage" (singular and plural) separately but not employing the phrase "loss and damage." "No mention countries," category C, includes countries that did not report on loss and damage at all.

Based on the total sample of 168 countries (see Table 2), 35.1 percent of countries report on "loss and damage", 33.3 percent of the countries broadly report on climate change negative impacts by either mentioning loss and/or damage, 31.5 percent of countries do not report on loss and damage in any form.

The fact that more than one-third of countries' NDCs explicitly mention "loss and damage" is indicative of the relevance the issue is gaining among vulnerable countries. The Paris Agreement and the guidelines of the Enhanced Transparency Framework (UNFCCC, 2022c) do not mention loss and damage among the information Parties are expected to include in these documents. Therefore, any reference to

Table 1. Country grouping for the NDC analysis

Country Group	Country Code	Description
L&D mention	A	A country reports on "loss and damage" explicitly in the NDC.
Other mention	B	A country reports separately on "loss" and/or "damage" but not on "loss and damage" in the NDC.
No mention	C	A country does not report on loss and damage in any form in the NDC

Box 5. Non-economic loss and damage: climate-induced migration and agriculture in India

Climate change will play a defining role in shaping lives and livelihoods in India over the coming decades. According to the Global Climate Risk Index (Eckstein, Kunzel and Schafer, 2021), India is among the world's most vulnerable countries to the impacts of climate change. Its vulnerability is exacerbated by a high percentage of rainfed agriculture and a prevalence of landless, marginal and small farmers (SDC, 2020) who have a limited capacity to adapt when confronted with climate impacts.

Climate change is expected to exacerbate losses and damages within India's agriculture sector, which employs 70 percent of rural households (FAO, 2023a), with dire implications for crop yields and food security. For example, a rise in average temperatures between 1°C–4°C could translate into a reduction in rice production by 10–30 percent and maize production by 25–70 percent (IPCC, 2022c). This would have devastating consequences for states like Odisha, where nearly 78 percent of farmland (SLBC, n.d.) is dedicated to rice paddies. The frequency, intensity and duration of heatwaves is already on the rise in India due to climate change. In March 2023, temperatures reached 3°C–8°C above average, the warmest since recording of temperatures began in 1901 (Rajeevan *et al.,* 2023). The heatwave struck at a critical time in the growing season destroying crops. Floods have also wreaked havoc in India in recent years, causing considerable loss and damage. In 2022, the country experienced significant monsoon flooding, killing over 2000 people (ReliefWeb, 2023) and forcing over 2 million people (IDMC, 2023) from their homes. Flood-induced economic losses and damages amounted to USD 4.42 billion (ReliefWeb, 2023).

Beyond economic L&D, agricultural workers are also disproportionately affected by non-economic forms of L&D, such as adverse health impacts and the loss of lives due to exposure to climate-related hazards and extreme weather. Climate-related L&D in agriculture influences the decision to migrate among rural folk. Indeed, flooding and drought have been shown to increase people's propensity to migrate in India (Bharadwaj *et al.*, 2021). Migration, in turn, is increasingly recognized both as a symptom and source of L&D. On the one hand, it is an age-old livelihood diversification and risk spreading strategy, which can support adaptation to climate change (Black *et al.*, 2011) in the context of rural livelihoods. On the other hand, migration presents challenges for migrants and their households. Migrants may face heightened vulnerabilities, including the risk of exploitation and discrimination in their destination areas. Social and cultural ties within communities may be disrupted, potentially affecting traditional knowledge and practices related to climate adaptation (LSE, 2023). Furthermore, migration alters intra-household dynamics, roles and responsibilities with implications for the well-being of family members who remain behind.

Implementing adaptation measures in agriculture, such as climate-smart farming practices (IIED, 2021), can help mitigate loss and damage by making rural livelihoods more resilient, thus reducing the risk of displacement and high-risk migration. FAO and the International Organization for Migration (IOM) are supporting government counterparts

to strengthen the resilience of communities at risk of climate-induced migration in the coastal areas of Odisha State and in the drought-prone areas of Telangana State. The aim is to build resilient and sustainable livelihoods, minimize L&D and provide tailored support to family members who stay behind, especially women and children, to enhance their capacity to adapt to climate change and mitigate the negative impacts of migration. In this context, rural households are supported to improve access, ownership and use of climate-smart, water saving and labour-saving technologies. Community-led knowledge sharing mechanisms, such as rural radio and wall writing, are used to empower rural people by enhancing peer-to-peer learning and sharing of information on climate-resilient livelihoods and experiences about migration. In addition, state and local stakeholders, including policy and decision-makers, are trained to recognize and act on the linkages between migration, agriculture and climate change and to identify and minimize non-economic loss and damage at the intersection of these processes.

the concept is likely to imply the choice to signal its importance for the national context.

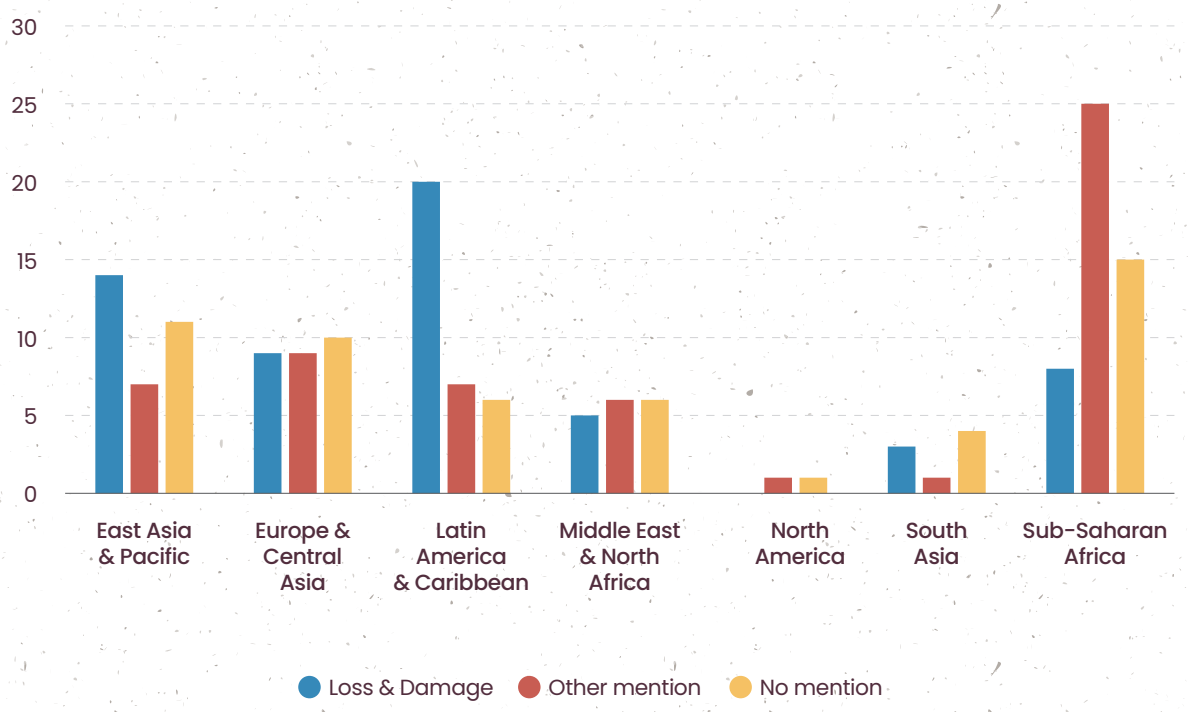
In terms of the geographical range, countries mentioning loss and damage (L&D mention countries) are mostly located in the Latin America and the Caribbean regions, followed by East Asia and the Pacific and Europe and Central Asia (Figure 4). These results confirm previous analysis showing that L&D is becoming an increasing concern for a wider group of vulnerable countries on top of traditional players like SIDS and LDCs (Calliari and Ryder, 2021). Sub-Saharan Africa, instead, has a relatively low number of NDCs mentioning L&D compared to other regions. This might look surprising considering that the region is highly vulnerable to the impacts of climate change, but it could depend on the type of information that Sub-Saharan countries decided to include in their NDCs (e.g. information focusing on wider

Table 2. Number of countries per region

Region	Number of countries
East Asia & Pacific	32
Europe & Central Asia	28
Latin America & Caribbean	33
Middle East & North Africa	17
North America	2
South Asia	8
Sub-Saharan Africa	48
Total	**168**

Source: Calculations by the authors based on the NDCs.

Figure 4. Regional spread of countries by reporting group



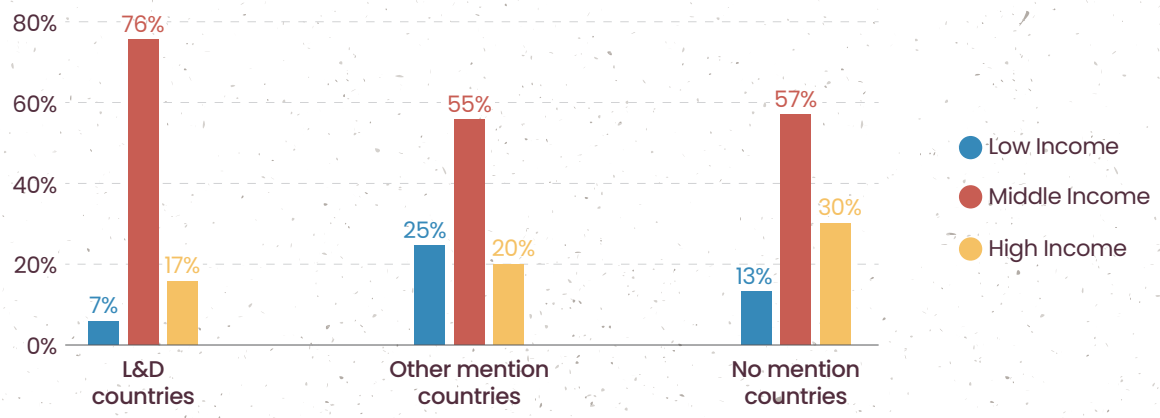
Source: Estimations from the authors based on the NDCs.

climate change impacts). There are very few rules about the information that NDCs should include, and it is eventually up to the countries to decide. As such, the inclusion or exclusion of L&D language in NDCs do not necessarily reflect the extent of losses and damages experienced and/or projected at the country level, but rather the choice to focus or not on the issue within the document.

"Other mention" countries show a large majority from Sub-Saharan Africa followed by Europe and Central Asia, Latin America and the Caribbean countries and East Asia and the Pacific. Countries not mentioning L&D at all (no mention) are more evenly spread across regions but tend to be primarily located in Sub-Saharan Africa, followed by East Asia and the Pacific and Europe and Central Asia.

Within the group of countries explicitly mentioning L&D, just over three-fourths of the sample are middle-income countries, 17 percent are high-income countries and 7 percent are low-income countries (Figure 5). This is consistent with the fact that most mentions come from Latin American and Caribbean Countries. The spread for "other mention" and "no mention" countries is smoother, with 55 percent of "other mention" countries in the middle-income group, 25 percent in the low-income group and 20 percent in the high-income group. For "no mention countries," 57 percent is from the middle- income group, 30 percent from the

Figure 5. Income levels by country group



Source: Estimations from the authors based on the NDCs

high-income group and 13 percent from the low-income group.

Overview of the sector analysis

The number of countries that report on L&D in NDCs is 59 (see Figure 6). Most of the countries that mention loss and damage in the NDCs refer to economic losses, of which 40 percent explicitly refer to the agriculture sector, 28 percent to the non-agriculture sector (e.g. tourism, etc.) and 33 percent do not specify any sector. This shows that for countries reporting on L&D, agriculture is the single most impacted sector overall. In terms of non-economic losses, countries' NDCs mentioning loss and damage report that 33 percent of the non- economic losses are related to the agricultural sector, 27 percent to non-agricultural sectors and 40 percent all other sectors.

Only a small sample of countries' NDCs (8 out of the 59 L&D countries) mentions slow-onset events as the type of events causing economic L&D (see Figure 7). Out of this small group, four NDCs tie the reporting to agriculture, two to the non-agriculture sector and two countries do not specify the sector. These results do not differ substantially when it comes to non-economic losses.

Figure 6. Economic and non-economic losses and damages for loss and damage mentions

Sector	Economic losses		Non-economic losses	
	Number of countries	Share (%)	Number of countries	Share (%)
Agriculture	17	40	5	33
Non-agriculture	12	28	4	27
Not specified	14	33	6	40
Total countries with mentions	43		15	

Source: Estimations from the authors based on the NDCs.

Figure 7. Losses and damages from slow-onset events

Sector	Economic losses		Non-economic losses	
	Number of countries	Share (%)	Number of countries	Share (%)
Agriculture	4	50	3	43
Non-agriculture	2	25	2	29
Not specified	2	25	2	29
Total	8		7	

Source: Estimations from the authors based on the NDCs.

The number of countries' NDCs explicitly mentioning extreme weather events as L&D drivers is larger (See Figure 8), with a total of 35 countries reporting economic losses from extreme weather events. In particular 37 percent of the mentions are related to the agriculture sector. On the other hand, the reporting on non-economic losses is small, with two out of eight countries linking them to the agricultural sector.

Figure 8. Losses and damages from extreme weather events

Sector	Economic losses		Non-economic losses	
	Number of countries	Share (%)	Number of countries	Share (%)
Agriculture	13	37	2	25
Non-agriculture	10	29	2	25
Not specified	12	34	4	50
Total	35		8	

Source: Estimations from the authors based on the NDCs.

Kurigram, Bangladesh - Mst Sarzina Begum, 30, lives in the Shakhahati village of Chilmari upazila in Kurigram district.

3 Responding to Loss and Damage in Agrifood Systems

Climate and disaster risk management provides a comprehensive framework on which actions to minimize and address L&D in the agriculture sector can build. It relies on the integration of different approaches to manage the interactions between climate changes, natural hazards, biological and technological hazards, and their impacts on people, communities, and ecosystems (UNDRR, 2020). These approaches include disaster risk management (DRM), climate change adaptation (CCA) and Disaster Risk Reduction (DRR). UNDRR (2020) also includes health-emergency disaster risk management (Health EDRM) as a relevant approach for CDRM. DRM considers a continuum of interrelated actions implemented before, during and after a disaster, which are usually grouped around the phases of prevention, preparedness, response, and recovery (including rehabilitation and reconstruction). CCA and DRR have a common focus on anticipating, avoiding, preventing, and financing risks as well as absorbing remaining impacts (Mechler and Schinko, 2016). These approaches stem from different (although increasingly connected) scientific and practice communities, which are often coordinated by different institutional actors and rely on different sources of funding. However, they mostly overlap and rely on a wide set of common measures, which allow for a comprehensive response to L&D before, during and after a disaster strike.

Building on these approaches, the section highlights and discusses several action areas and related measures relevant to responding to loss and damage from an agrifood systems perspective. While not a specific measure *per se*, the first action area highlights the need for national actors to engage more with the concept of L&D, while reflecting on its relevance to national agrifood systems and the action required to protect them. L&D to date has been discussed extensively during climate negotiations, but policymakers and other relevant actors working in agriculture on the ground are not necessarily familiar with the concept and might need to engage more in what it means in a national context.

The areas where action should be taken encompass: climate risk assessment; data collection and assessment requirements; implementation of DRR and CCA measures to minimize the adverse impacts of climate change in agrifood systems, including through ecosystem based solutions; anticipatory measures to protect the productive assets of farmers, herders and fishers before a disaster strikes based on early warning or forecasts; emergency response; and recovery, rehabilitation and recon-

struction towards resilient agrifood systems. The section describes examples of FAO's work across these areas to showcase how support for vulnerable countries can provide responses to loss and damage, and highlights domains where further work is needed.

1) Clarifying what losses and damages means for national agrifood systems and identifying relevant domains and responses.

Losses and damages can greatly differ from country to country, both in terms of the economic and non-economic losses. Economic losses are dependent, for example, on the type of agricultural activities carried out or the relative importance of the sector for the national economy. Non-economic losses, which cover the wider non-monetizable implications for natural and human systems, can materialize as deterioration or loss of traditional livelihoods, erosion of indigenous or traditional knowledge systems, migration to urban settings, and impacts on physical and mental health that are very context-specific (Tschakert *et al.,* 2019). It is important to identify which L&Ds are the most critical in each locality, to select the *ex ante* and *ex post* measures that can and need to be put in place. These would include measures that expand the adaptation frontier, that is, by acting on financial, technical, or institutional constraints to adaptation in the agricultural sector, as well as *ex post* curative measures. Tracing the L&D landscape is also the first step necessary for raising awareness among relevant actors, facilitating the inclusion of the concept in strategies and planning instruments, and identifying relevant responses.

2) Enhancing climate risk assessment for supporting losses and damages management in the agricultural sector.

A key prerequisite to managing risks is understanding them. This is crucial when informing DRR and adaptation efforts across all sectors as well as emergency preparedness and response (UNISDR, 2017). Risk assessment includes the review of the technical characteristics of the hazards (location, intensity, frequency, probability), the analysis of the exposure and vulnerability including the physical, socioeconomic and environmental dimensions, and the evaluation of coping capacities against different risk scenarios (UNISDR, 2009). With respect to the agricultural sector, FAO supports national policymakers in their efforts to assess climate risks through several initiatives, including the Climate Risk Toolbox (CRTB). The CRTB supports climate-focused decision-making through the visualization of climate risk hotspots by identifying hazard probability, exposure and vulnerability of targeted agricultural systems and communities.

3) Investing in data collection and research to track the nature and extent of loss and damage caused by climate change impacts.

Collecting information about the nature and extent of L&D is crucial to providing a baseline for future actions and helping assess the effectiveness of L&D responses. Recent methodological advancements are gradually making progress *vis-à-vis* the measuring of L&D caused by natural disasters in the agricultural sector. Attributing the actual share of losses and damages due to climate change is still challenging: however, quantifying the monetary damage to agriculture assets and infrastructure and the value of production losses

attributed to disasters can generate important knowledge to inform resilience policies and measures (Conforti *et al.,* 2020). Section 2.2 of this report discusses emerging approaches, including the "damage and loss assessment methodology" developed by FAO for identifying, analysing and evaluating the impact of disasters on agriculture, including crops, livestock, aquaculture, fisheries and forestry.

Modelling methodologies can also be employed to estimate economic losses and damages. As highlighted in the methodological section, the development of such methods that would also integrate agrifood systems more consistently, is ongoing. Several challenges, however, still need to be addressed.

At the same time, greater consideration should be given to identifying and evaluating non-economic losses representing an equally important component of climate change impacts as experienced at the individual, community and societal level (e.g. losses of cultural heritage, traditional livelihood, and ecosystem services). Qualitative or survey-based approaches, as presented in Section 2.2, can help better qualify the impacts suffered at the community and household level, including those that are non-economic in nature. Citizen science can also play an important role in this area. For example, the NGO/Sustainable Environment and Ecological Development Society (SEEDS) of India, in partnership with the Government of India, is developing a national climate loss and damage open digital platform (Akshvi) that will rely on a database built by affected communities, and provide information on the nature and extent of loss and damage with both economic and non-economic values.

4) Adaptation and disaster risk reduction for minimizing loss and damage in the first place.

Several measures can be implemented to reduce disaster and climate risks and the underlying vulnerabilities of the agricultural sector. FAO is supporting the implementation, adoption, and uptake of DRR, CCA and climate-smart agriculture (CSA) good practices at farm and landscape levels to reduce multiple risks and vulnerabilities, while at the same time, increase agricultural production as well as socioeconomic and environmental benefits, such as improved natural resources and ecosystem services. A multi-year study that FAO conducted revealed that investment into risk reducing farm-level DRR good practices perform 2.2 times better than previously used practices under hazard conditions (low intensity, high frequency hazards, including cold waves, strong winds, frost, snow, heavy rainfall, flooding, drought, high temperature and pests). In monetary terms, the benefit-cost ratio was 3.6 under hazardous conditions and increased to 4.3 under non-hazardous conditions The examined good practices included for instance, livelihood diversification measures, irrigation and livestock shelter infrastructure, integrated livestock management and the use of drought- and flood-tolerant crop varieties. More emphasis needs to be placed on the farm and landscape level in agriculture sector strategies, as this is an effective and relatively low-cost way to prevent and mitigate the types of disasters that most often affect vulnerable smallholders (FAO, 2023).

With respect to fishery, adaptive capacity and resilience can be achieved through the development of climate-proofed fisheries infrastructure, such as ports, jetties, slipways, fish

Box 6. Losses and damages in Chile: assessment and policy mechanisms

The IPCC Report has classified Chile as a country highly vulnerable to the effects of climate change. According to the climate change trends described by the Chilean Meteorological Directorate, these effects are characterized by a systematic decrease in annual rainfall. In addition, intense precipitation events have contributed to a rise in the minimum and maximum temperatures. As a result, this translates into scenarios of a high probability of droughts, floods and landslides, in addition to an increase in the likelihood of new pests and diseases developing due to these new conditions.

The Ministry of Agriculture of Chile, thanks to the support of FAO, studied and institutionalized the methodology developed by FAO for agriculture and forestry to assess damage and direct economic losses caused by disasters. This meant piloting an automatic calculation module within its disaster response information system. The damage and losses pilot platform is a successful and important step to demonstrating the possibility of the automatic and effective calculation of the C-2 indicators in real time, in forestry and agricultural emergency situations. For instance, it allowed for the calculation of damage and losses related to forest fires that occurred during the 2023 summer season, and damage to the agriculture sector produced by the floods that hit key agricultural land in June 2023. A proposal was made to establish a form of systematic calculation to report pertinent indicators under the Sendai Framework for Disaster Risk Reduction and Sustainable Development Goals (SDGs). Data has also been used as input for planning emergency assistance (cash transfers) provided by the government to the producers concerned, and to improve the historical record of disasters affecting this sector in the country. The process involved shifting from paper-based field data collection to using digital tools such as Kobo toolbox.

The current challenge remains to improve the platform so that it can receive much larger amounts of data, since the original one set up by the Ministry of Agriculture was not large enough to host data for the more recent and numerous emergencies being faced. Also, provisions should be made to update baseline data since, over time, prices of inputs and crops and other baseline data are dynamic. The economic evaluation of disasters in the agricultural sector is tremendously complex, as well as specific to each country. Each productive system or agricultural method is subject to what the climate permits, the adaptation conditions that the productive systems offer, and the economic benefits that can be obtained from these activities. Therefore, the D&L assessment for Chile has been a continuous learning process, and collaboration between institutions across the government is key. Since the baseline data is fragmented, the collaboration and coordination of many different entities is essential, because sharing data is not part of the country's culture. Therefore, a special effort must be made, which takes time. For these reasons, it is important to have a solid emergency management governance structure and to improve the reporting platform for the Sendai framework to make it easier to use, including use of data across involved actors. The digital data collection tools that upload and synthesize information directly onto the cloud make the task much easier and, nowadays, incorporating these tools does not represent a particularly significant cost. Expanding this capacity to other types of impacts, such as socioeconomical and environmental, would provide a better account of the real impact of disasters and further refine the assistance and risk management instruments. There is still considerable potential for exploration as regards the utilization of this type of data. For example, in Chile this data is mainly used for emergency decisions and reporting, however thus far, not for prevention.

buying stations and fish markets as well as more climate-resilient fishing boats. Additionally, the integration of early warning systems directly adapted for fishers, for example, in the form of local weather monitoring with information delivered to fishers through smartphones and radio, or during community meetings, can provide lifesaving information about upcoming strong weather events. Moreover, considering the escalating climate change and disaster risks, it becomes imperative to provide fishers with safety training and develop and promote fishing vessel safety standards.

Nature-based solutions are also increasingly being employed to enhance resilience in agriculture and food production, while mitigating climate change and providing environmental and social benefits. Examples include: i) conservation agriculture (e.g. cover crops for fallow period, and practice from reduced to zero tillage); ii) agroforestry, grazing optimization (e.g. improving grazing intensity, and pasture management to reduce GHG emissions); iii) improved water management and drainage in rice cultivation, homestead garden including roof-top gardening and vertical/multi-layered farming (e.g. nurturing local crop varieties, and enhancing agro-diversity); and iv) an ecosystem approach to aquaculture. There are also opportunities for fisheries to contribute to carbon sequestration and blue carbon ecosystems through holistic fisheries' management with measures such as mangrove preservation and restoration. Estuaries and nearshore canyons serve as valuable habitats for multiple species and actively sequester carbon.

Specific measures can also be taken to enhance resilience at the societal level. These include risk-informed and shock-responsive social protection systems and insurance schemes to protect livelihoods. Social protection systems build on three key types of interventions: i) social assistance, as non-contributory programmes aimed at supporting particularly vulnerable groups through cash or in-kind transfers; ii) labour market programmes and policies; and iii) social insurance interventions, as contributory programmes aimed at protecting individuals and households against shocks and stresses. At the system level, social protection can play a crucial role in connecting emergency and post-disaster measures with longer-term development interventions that aim to restore the livelihoods of rural populations (FAO, 2021d). Agricultural insurance can effectively complement social protection by reducing farmers' vulnerability to disasters from the micro to the macro level. For instance, ACRE Africa's index insurance scheme, combines weather-based index insurance with inputs, such as maize seeds, that farmers buy in Kenya. Farmers pay a small premium when buying a bag of seeds, which also includes a scratch card with a code. The farmer activates the card by sending a text message with the code to ACRE when they start planting the seeds. If in the following 21 days there are enough days without rain, which is monitored using satellite imagery, then the participating farmers immediately receive their money back via their mobile phone. This timely claim settlement may also allow farmers to purchase another bag of seeds and not miss the entire planting season. The usage of the mobile phone to conduct transactions has been one of the key drivers of this product's success as it provides an affordable distribution system for the insurer and it is easily accessible for the

customer. In this way, small-scale farmers are reached through mobile technology and one of the main barriers to selling insurance was overcome, namely the lack of customer's trust. This was addressed through providing small amounts, as little as a bag of seed, so that farmers could 'test' the product and not risk losing a large amount.

With respect to the built environment, the risk proofing of infrastructures along the food value chains can enhance the resilience of the agrifood sector in its entirety.

5) Anticipatory action for reducing loss and damage before a disaster strikes.

There is growing evidence that anticipatory action is both more effective and cost-efficient in saving lives and livelihoods than an *ex post* response, while upholding the dignity of people. FAO estimates that households can gain up to USD 7 for every USD 1 invested in avoided losses and added benefits (FAO, 2021d). These benefits go beyond the monetary level such as for example, addressing food insecurity, bolstering resilience initiatives, and reducing the need to revert to negative coping strategies such as selling of assets or borrowing money. Anticipatory action is an approach that links early warning information with flexible funds to trigger actions that mitigate the impact of predictable shocks on the most vulnerable people. Acting in anticipation of forecast shocks allows households to protect their livelihoods and preserve their assets (FAO and WFP, 2023). In the agricultural sector, actions can take many forms, from supporting farmers with water harvesting or drought-resistant seeds to mitigating the impact of drought, to repairing of flood control infrastructure or waterproof drums to store seeds, tools and harvest protecting them from flooding. Similarly, actions can go from granting financial assistance to fishermen for safeguarding their vessels and equipment before a storm, to endowing pastoralists with animal feed and vaccines to ensure livestock survival and well-being before droughts.

In the case of Mongolia, for example, FAO support in protecting livestock ahead of the Dzud (Dzud: phenomenon arising from summer drought followed by heavy snowfalls combined with extreme cold, resulting in insufficient grazing pastures and livestock mortality) in 2019 helped reduce animal mortality and maintain animal body conditions through the harsh winter. Avoided damages and losses amounted to more than 7 USD for every dollar invested. In the Philippines, FAO provided vegetable gardening kits for backyards and small community-run poultry farms to vulnerable households in Mindanao before they were cut off from their farmland ahead of a looming drought across 2018–2019. Those who did still have access to their rice paddies received drought-resistant rice seeds ahead of the dry spell, so they could plant, after having lost their crops and seeds in two previous droughts. In all, FAO impact study of these operations revealed that Mindanao farmers received USD 4.4 in benefits and avoided losses for every dollar FAO invested. Similarly, positive returns have been observed in Afghanistan thanks to livestock protection interventions that FAO has implemented ahead of predicted drought in 2021. In view of such potential in minimizing loss and damage, FAO sees anticipatory action as integral to its emergency and resilience interventions as overall climate action. Since 2016, FAO has been consistently investing in capacities to implement antici-

patory actions by strengthening Early Warning Systems, which are a necessary foundation for anticipatory action, developing anticipatory action plans, and mobilizing human and financial resources. Currently, anticipatory action is integrated in FAO corporate Strategic Framework 2022–2031 and the Strategy on Climate Change 2022–2031.

6) Emergency response to put communities back on their feet.

When disaster strikes, people often require food relief. However, this must also be accompanied by agricultural relief, with the aim of helping people transition from humanitarian assistance to becoming self-reliant (FAO, 1998). Specific responses in the agricultural sector encompass the provision of resources, seeds, animal feed, equipment and tools to safeguard agricultural livelihoods after a disaster (OECD/FAO, 2021). Similar activities are carried out for fisheries where communities are provided with fishing boats, gears and processing equipment to restart fishing as soon as possible to ensure food security and livelihoods to the communities involved, as was the case of Hurricane Dorian in the Bahamas in 2019.

FAO develops emergency livelihood response plans soon after an emergency declaration is issued. This is an illustration of FAO's contribution to the UN Humanitarian Appeal and/or Government Response Plan for the agriculture sector. The plan outlines interventions that can be implemented in a 12-month period aimed at helping the affected population rapidly resume local food production and earn an income. It provides scope for bridging the emergency response with rehabilitation and development assistance required for agricultural livelihoods resilience building. Resilience/multi-year strategies are also developed for countries affected by recurrent shocks, stresses and/or a protracted crisis. The strategies link all emergency and resilience activities and their different timeframes into a common overall plan, explaining how they combine and leverage each other to help different groups of households overcome acute food insecurity and build resilience in the face of future crises. In 2022, in South Sudan FAO helped to enhance risk-informed planning, decision-making and resilience building through livelihood tools, kits, and seeds to support the recovery of affected people. It also provided technical extension services through training for farmers who have been affected by floods to implement climate smart agriculture to protect their assets from future hazards.

7) Recovery, rehabilitation and reconstruction towards resilient agrifood systems.

These three phases are not only about regaining what was lost, but they are about "building back better" with the objective of tackling the root causes of vulnerability leading to L&D and enhancing the resilience of agrifood systems to reduce future risks. Actions in these phases can include upgrading and modernizing farming practices, introducing climate-resilient techniques, and investing in climate-proof infrastructure. For instance, in Somalia FAO has supported the development of better embankments and dike designs for enhanced resilience and sustainability, while maintaining irrigation access. These designs have become standard now for the Ministry of Agriculture and Irrigation.

Box 7. Taking action to confront loss and damage in fragile states

In collaboration with the Green Climate Fund (GCF), FAO has been or is supporting Afghanistan, Burkina Faso, the Republic of the Congo, Nigeria, Sudan, Syria, and Yemen to support governments and communities to strengthen capacity and strategies to avert, minimize and address loss and damage by laying the groundwork for sustainable, inclusive and climate-resilient agrifood systems.

In addition and with other bilateral and multilateral partners, in Syria and Afghanistan, irrigation networks, irrigation networks set up to support agricultural productivity and sustainable use of water resources are being rehabilitated through a mix of humanitarian and development financing.

In Somalia, food insecurity is affected by the lingering impacts of the recent drought, protracted conflict, and high food prices and is at risk of further deteriorations given the likelihood of widespread flooding between October and December, induced by the combined impacts of an ongoing El Niño and positive Indian Ocean Dipole (IOD). FAO has extensive reach and capacity in remote rural areas to deliver cash and livelihood support in time to those most in need. Every US dollar spent to protect agriculture livelihoods can save around USD 10 in food-related assistance for displaced families. For the ongoing El Niño/positive IOD flood risks, FAO-Somalia has already taken many anticipatory actions to reduce the expected impacts or losses, including closing river breakage points and rehabilitating other water infrastructure to reduce flooding, prepositioning of sandbags in flood prone areas, and developing and transmitting flood-related early warning messages to the communities most at risk. However, additional investment in prevention, anticipation, emergency preparedness and adaptation capacities still will require more consideration.

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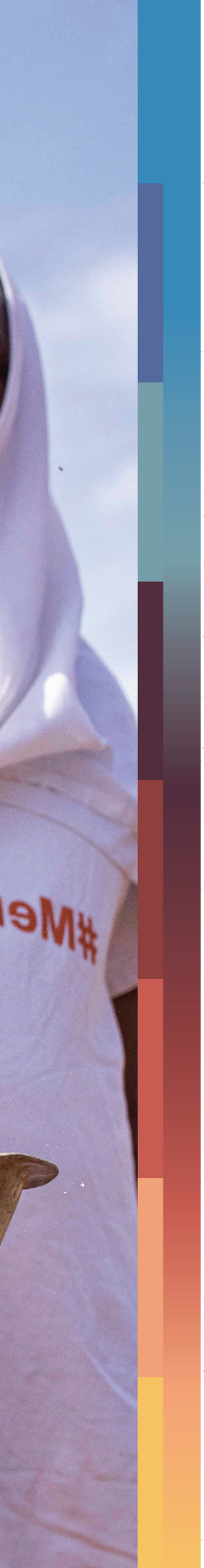
Sanga, Laikipia County, Kenya - Kenyan herbalist Anna Kirobi prepares a pot while making herbal medicine remedies at her home in Sanga, Laikipia County, Kenya on August 10, 2021 within the Mukogodo Forest.

4 Financing for Loss and Damage



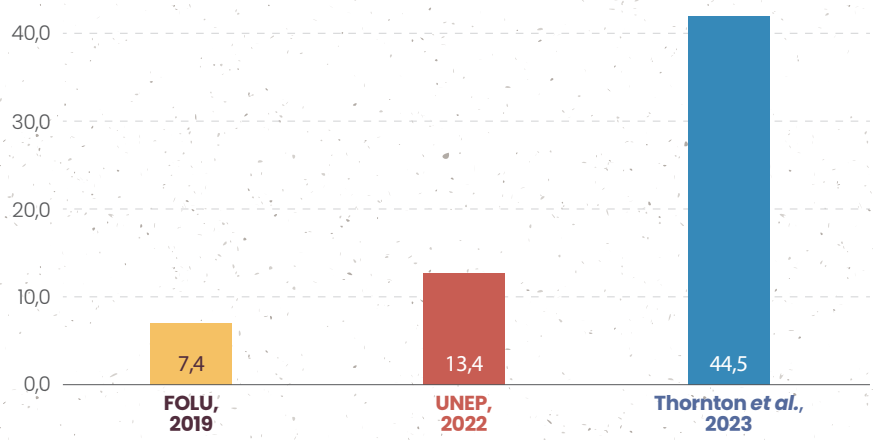
4.1 Financing Context and Requirements

The number of losses and damages in agrifood systems is significant, although the portion specifically to be attributed to climate change has still not been fully assessed. Finance will be needed to cover these losses and damages. There is no estimate available with regard to the need for finance for loss and damages in agrifood systems – the only existing starting point is climate finance. Estimated climate finance for agrifood systems is currently related only to mitigation and adaptation.

When assessing the needs for climate finance for agrifood systems, there are still gaps between the estimates of the required financing and the current financial flows. Furthermore, current financial flows are mostly untracked for losses and damages, which hinders the potential comparison between needs and availability from the start (UNFCCC, 2023c).

In 2019/20, tracked climate finance related to the agrifood sector amounted to 4.3 percent of total project-level climate finance. This share is equivalent to an annual average of USD 28.5 billion. This annual average is compared to three estimates of the reported needs for climate finance within agrifood systems, see Figure 9. The estimates range from a minimum of USD 212 billion up to a maximum of USD 1 267 billion per year up to 2030 (CPI, 2023).

Figure 9. Financing needs vs. tracked finance for agrifood systems



Note: vertical axis reports the ratio of estimated needs (according to three different sources) over tracked project level finance for agrifood systems.
Source: Based on data and sources as reported in CPI (Climate Policy Initiative). 2023. Landscape of Climate Finance for Agrifood Systems. Chiriac, D., Vishnumolakala, H., Rosane, P.

However, the analysis highlights significant limitations affecting tracked finance data, and these numbers should be interpreted with care. The limitations reported include the lack of a standardized approach to collecting financial data for climate change and the differences across sectors. Keeping these caveats in mind, Figure 9 highlights that the forecasted financial needs would be (in the most "conservative" case) more than seven times larger than current climate change financing (tracked at project level) for agrifood systems. (CPI, 2023).

Given the current limitations of the data on loss and damage, it is not yet possible to explicitly define the amount of financing required for losses and damages to agrifood systems, and the amounts mentioned broadly refer to agrifood systems overall. This calls for additional data collection and analysis.

Table 3 lists the amounts of project level financial flows tracked by CPI (2023), highlighting the different identified instruments and their role in the overall assessed amount. The most important types of instruments are debt and grants. In the context of debt, debt financing at market rates has the largest share (CPI, 2023).

Table 3. Agrifood sector climate finance flows (project level data)

Instrument	Value
Grants	USD 10.8 billion
Project level market rate debt	USD 8.9 billion
Low-cost project debt	USD 3.8 billion
Project level equity	USD 0.9 billion
Balance sheet financing (debt)	USD 0.8 billion
Balance sheet financing (equity)	USD 0.3 billion
Unknown	USD 3.1 billion

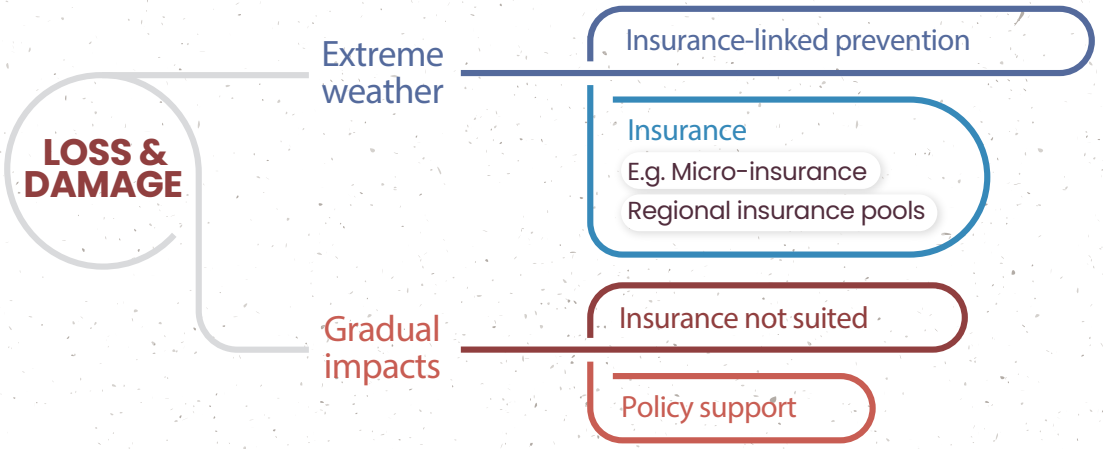
Source: Based on data and sources as reported in CPI (Climate Policy Initiative). 2023. Landscape of Climate Finance for Agrifood Systems. Chiriac, D., Vishnumolakala, H., Rosane, P.

While a fully detailed analysis is not possible for L&D in the agricultural sector, it is interesting to note that both public and private funding sources can be tracked in the context of project level agrifood systems climate finance. Public finance is the major funding source. Major public entities involved are development finance institutions and governments. As for private sources, the largest available ones appear to rely on commercial finance institutions (CPI, 2023).

The trends of the climate-related development finance may be informative when considering the need to increase financial flows towards agrifood systems. Nonetheless, while this type of finance increased in the period 2000–2020 in general, the share of climate-related development finance allocated to agriculture and land use sector has decreased. This contributes to the fact that the agrifood system is not receiving adequate attention regarding financing needs (FAO, 2023f).

A broad set of financing instruments can be considered in relation to loss and damage. Here we focus on insurance and risk management strategies. The possibility of insurance to cover L&D costs without relying on *ex post* public intervention or private liabilities may complement other effective strategies for climate-related losses remediation (UNFCCC, 2023c). A significant opportunity is open in this respect, given the large gap between insured and total climate-related losses. In 2022, only a part of total losses related to natural catastrophes were insured, amounting to 45 percent of global losses related to natural catastrophes (SwissRe, 2023). The application of insurance has obvious limitations as a risk management tool (see Figure 10), one of the main limitations being related to the nature of the event. This is

Figure 10. Risk management applications of insurance



Source: Adapted from Linnerooth-Bayer et al. 2019. Insurance as a Response to Loss and Damage? In: Mechler, R., Bouwer, L., Schinko, T., Surminski, S., Linnerooth-Bayer, J. (eds) Loss and Damage from Climate Change, pp 483–512. Climate Risk Management, Policy and Governance. Springer, Cham.

the case with events that occur gradually, such as sea-level rise, desertification, loss of biodiversity and other (Linnerooth-Bayer *et al.,* 2019).

Some of the main beneficial roles that can be identified for insurance is risk pooling (for actors subject to disasters risk) and safety-nets for governments budgets. A risk premium that is larger than the average expected losses indicates that purely rural households may not be able to afford the premium, even though in principle insurance would be an efficient choice given the degree of risk aversion. These considerations are appropriate within the context of agriculture in developing countries, where we may expect high risk aversion both from households/farmers and from governments (Linnerooth-Bayer *et al.,* 2019 and cited literature). Ideally, insurance should bring successful results where other climate-related instruments fail or are inefficient, and it could therefore be adapted to the specific features of the problem in poor economic contexts. This need is related to more general sources of criticism of the adoption of insurance schemes to cover L&D impacts (Owen and Noy, 2019; Nordlander *et al.*, 2020).

Specific examples of insurance applied to L&D may help to understand how the general limits of these kinds of tools may be identified, and possibly overcome. For instance, (subsidized) micro-insurance schemes should be designed in such a way to allow for risk-pooling without reducing the incentives to cope with disaster risk *ex ante* and, at the same time, promoting equity across rural households (Linnerooth-Bayer *et al.,* 2019).

Several examples of a practical implementation of the potential for weather index-based crop insurance are worth mentioning, albeit the implementation of these kinds of tools still appears to be limited. Effective disaster risk management and climate change adaptation approaches should go beyond traditional credit provision and disaster relief programmes to effectively safeguard and reach a wider ru-

Box 8. Insurance mechanisms for climate change and Loss and Damage

A recent study (Aheeyar *et al.*, 2019) in South Asia identified several financial, cultural and knowledge-related challenges hindering the promotion of crop insurance. To overcome contextual barriers to crop insurance, options could be adapted and designed by aligning with local contexts and stakeholder preferences and using diverse communication channels to improve farmers' understanding of the products to build trust, increase farmers' access, and lower the transaction costs by partnering with local non-government organizations (NGO) and multilateral financing institutions. Consequently, this would make the eligibility criteria flexible and ensure affordability of the premium. Despite the challenges Sri Lanka is faced with, public risk transfer mechanisms (SLYCAN Trust, n.d.) running since 1958, include a universal crop insurance covering all farmers (National Natural Disaster Insurance scheme) and a loan protection scheme for financial institutions. The government's crop insurance scheme covers the cultivation of all registered farmers for six basic crops and can be expanded if farmers wish to cover other crops, livestock, equipment, storage facilities, or health by paying a separate premium against losses and damages due to floods/excess water, droughts/dry spells, and pests/diseases.

In 2022, the UN Capital Development Fund initiated a micro-insurance product to protect Vanuatu's climate-vulnerable populations, including women, girls, and indigenous people, from the negative impacts of climatic extremities. Within 10 to 14 days after a natural calamity has occurred, this product provides relief funds to smallholder farmers, fishers, Micro, Small and Medium Enterprises (MSME), women-headed households, and people with disabilities.

The Satellite Index Insurance for Pastoralists in Ethiopia, provides pastoralist and agropastoralist households access to insurance against droughts in exchange for their contribution to various soil and water conservation activities to reduce the communities' long-term climate vulnerability (WFP, 2019). This index-based livestock insurance product is triggered when the vegetation is below the average growth thresholds, indicating that pasture and fodder availability may be reduced for livestock. The insurance payouts are distributed to pastoralists' households quickly, so that pastoralists can take urgent steps to protect their herds and avoid distress sales during drought periods.

The Asian Development Bank (ADB) has been implementing a Pilot Project on Weather Index-Based Crop Insurance to develop and implement weather index-based crop insurance in Bangladesh as an adaptation tool to reduce the climate variability and extreme weather, and vulnerability of the agriculture sector especially impacting small farm households. Climate-induced disasters and other extreme weather events affecting mostly the country's agricultural production such as floods, droughts, cyclones, storm surges and salinity intrusion are directly related to climate change loss and damage (ADB, 2023).

Green Delta Insurance and Sadharan Bima Corporation are working to promote the agricultural insurance system (both at micro and macro level), which ultimately contributes to the loss and damage of agricultural sectors in Bangladesh.

ral population. This can be achieved, in fact, through weather index-based crop insurance as an innovative risk adaptation tool for all types of farmers including small farm households. Weather index-based crop insurance is recognized as a tool that can overcome the flaws of traditional agricultural insurance, for example, when moral hazards, adverse selection, costly and time-consuming farm assessments are introduced.

4.2 Existing financing mechanisms relevant for loss and damage

Existing climate change mechanisms have been supporting some areas and elements of L&D. Here we outline how different financing mechanisms, such as the Global Environment Facility (GEF), the Green Climate Fund (GCF), and the Adaptation Fund (AF) are currently financing activities which are relevant for L&D. This is done through relevant projects, strategic developments, and potential entry points for L&D actions. Besides these three funds, financial resources relevant for responding to L&D can encompass a variety of global and regional risk-related funding streams from development banks, financial institutions and international organizations, which use a wide range of finance instruments.

Global Environment Facility

The GEF has been supporting investments that help countries address and reduce climate risks within the scope of climate adaptation and resilience. Under the GEF-8 Programming Strategy on Adaptation to Climate Change for the Least Developed Countries Fund (LDCF) and the Special Climate Change Fund (SCCF), the following themes have been prioritized: i) Agriculture, Food Security, and Health; ii) Integrated Water Resource Management to address water security, droughts, and flooding;

Box 9. Averting and minimizing loss and damage through GEF-FAO projects

Building strong and robust agro-climatic monitoring systems is an important measure to address loss and damage. In Laos PDR the Strengthening Agro-climatic Monitoring and Information System project strengthened the agro- climatic monitoring system for it to feed into effective decision making at country level, through improving institutions and technical capacity and the tools to support the policy formulation process. The tools included the Land Resources Information Management Systems and Agro-Ecological Zoning.

In The Gambia, the GEF and FAO have been working on strengthening the EWS for rapid responses to extreme weather events to strengthen capacity of the national hydrometeorology agency.

In Sao Tome and Principe, GEF and FAO worked on improving the safety and capacity of fishermen to deal with extreme weather events, such as intense storm surges, squalls, and dry fog. This was compounded by institution capacity building of marine meteorologists and the establishment of a marine meteorological station to improve monitoring and forecasting of the extreme weather events.

iii) Nature-based Solutions; and iv) Early Warning and Climate Information Systems. Interventions that address impacts of climate change on migration and displacement will also be supported.

In addition, the GEF-managed Global Biodiversity Framework Fund has been recently established to invest in the conservation and sustainable use of biodiversity and ecosystems, which are heavily threatened by wildfires, flooding, extreme weather, and human activities. This would be an example of financial resources relevant to address biodiversity loss, which is one of the climate change-induced non-economic losses.

Green Climate Fund

The GCF aims to evenly allocate resources (grant equivalent) between its two thematic areas (adaptation and mitigation). In 2019, decision 12/CP.25 invited the GCF to continue providing financial resources for activities relevant to averting, minimizing and addressing loss and damage in developing country Parties and to take into account the workplan of the WIM. In 2023, the Strategic Plan for GCF 2024-2027 proposes to support L&D by building on its track record of supporting integrated risk management approaches to extreme and slow onset events, and testing novel instruments such as parametric insurance as well as seek complementarity with other funding arrangements responding to loss and damage. Additionally, the GCF sectoral guides provide guidance on project development and appraisal to drive paradigm shifting pathways and demonstrating strong climate impacts across GCF investments. Both the Agriculture and Food Security and the climate information and early warning services guides identify many L&D relevant measures.

Currently, several approved GCF funding proposals — under the adaptation theme and targeting agrifood systems — have elements that are relevant to L&D actions. These actions include climate information services and early warning, improving knowledge of slow onset events, and disaster risk reduction and response (see Box 10).

Adaptation Fund

The AF covers numerous projects relating to the food security, agriculture, water management, rural development, disaster risk reduction and early warning systems, etc. The three areas for the new period include: 1) support for developing countries in the undertaking and acceleration of high quality, local-level and scalable adaptation projects and programmes that are aligned with their national adaptation strategies and processes; 2) modalities for funding the development and diffusion of innovative adaptation practices, encouraging the expansion of tools and technologies and risk-taking; and 3) knowledge and evidence on effective and innovative adaptation action and finance, including local and indigenous knowledge that is generated and disseminated with various stakeholders for application.

The new strategy highlights the important linkage of "adaptation" with L&D for capturing synergies, maximizing impact, and ensuring co-benefits, along with other related areas, such as health, biodiversity, oceans and marine ecosystems, conflict and fragility, migration, and climate mitigation.

Box 10. FAO-led GCF project in Nepal with loss and damage elements

The Building a Resilient Churia Region in Nepal project led by FAO has many elements that are supportive of averting and minimizing L&D. The project is expected to reduce climate change-induced economic losses in the Churia region by at least 50 percent compared to a business-as-usual scenario.

The Churia region is critical to maintaining the ecological and sociocultural functions of the densely populated Terai plains and ensuring people's food, water and energy security. The region is key to regulating surface water flows, and recharging groundwater. Rural men and women in the region are highly dependent on natural resources for food, water and energy but the region is extremely vulnerable to climate events such as heavy rainfall and flash floods.

Project activities aim at scaling up sustainable natural resource management through climate-resilient agricultural practices, ecosystem restoration targeting vulnerable river systems, soil and water conservation, riverbank stabilization, and sustainable management of forest resources. Reinforcing the resilience of ecosystems supporting the local agrifood systems and livelihoods is key to improving the capacity to address climate-related losses and damages. Investments will also help to avoid L&D that can have severe impacts on economic development of the region by reducing the risks and impacts of climate-induced hazards.

5 Moving forward

As climate change impacts continue to surpass the limits of adaptation, the discussion around loss and damage is progressively becoming a priority, especially in countries facing negative climate change impacts. Vulnerable and risk-prone countries are at the centre of this debate, with the fear that losses and damages will continue to increase. Agriculture and agrifood systems are recognized as a key and vulnerable sector in this context.

Moving forward, it is essential that countries identify and address the vulnerable elements in their own agrifood systems. The report has outlined a series of steps that can be taken to support this.

Finance will play a central role in moving forward. This will require specific ways to identify which loss and damage areas to support and how. Comprehensive risk assessment tools will be fundamental, in addition to the targeting of agrifood systems, one of the most vulnerable global sectors. FAO has been providing support for countries to help define country-specific strategies and identify loss and damage at the local level, to implement *ex ante* and *ex post* measures, and to subsequently move forward with strategies and actions. Stronger partnerships will be required to move ahead with loss and damage in the agricultural sector, to ensure that sustainable strategies and solutions can be identified, and that robust strategies for aversion and minimization are addressed, identified and implemented.

Based on the analysis in this report the following actions have been identified as important elements for moving forward with loss and damage in relation to agrifood systems:

Clarifying what losses and damages means for national agrifood systems and identifying relevant domains and responses. Losses and damages can greatly differ from country to country, both in terms of the economic and non-economic losses. Tracing the "loss and damage" landscape across all four sectors (agriculture, livestock, fisheries and aquaculture and forestry) is the first step necessary for raising awareness among relevant actors, facilitating the inclusion of the concept in strategies and planning instruments, and identifying relevant responses.

Enhancing climate risk assessment for supporting losses and damages management in the agrifood sector. A key prerequisite for managing risks is understanding them, and this is crucial to informing disaster risk

reduction and adaptation efforts across all sectors as well as emergency preparedness and response. With respect to the agrifood sector, FAO will continue to support national policymakers in their efforts to assess climate risks and this needs to be further strengthened to the loss and damage context.

Investing in data collection and research to track the nature and extent of loss and damage caused by climate change impacts. Collecting information about the nature and extent of loss and damage is crucial to providing a baseline for future actions and helping assess the effectiveness of loss and damage responses. Recent methodology allows for measuring the losses and damages caused by natural disasters in the agrifood sector, but this needs further development and application.

Implementing adaptation, disaster risk reduction measures and anticipatory action to reduce vulnerability of the agricultural sector and potential loss and damage before a disaster strikes. Several measures can be implemented to reduce the vulnerability of the agricultural sector. Examples of such measures include adjustments in ecological systems in response to actual or expected impacts such as crop diversification, use of crop variety that are more tolerant to heat or saline conditions, improvement of farming techniques, and water and soil conservation practices, as well as soil and ecosystem restoration. Enhancing the adaptive capacity and resilience of fishers and fisheries can also be achieved through the development of climate-proofed fisheries' infrastructure, such as ports, jetties, slipways, fish buying stations and fish markets. Anticipatory action is also key, as there is growing evidence that it is both more effective and cost-efficient in saving lives and livelihoods than an *ex post* response, while protecting the agency and preserving the dignity of the affected.

Strengthening and implementing emergency response to put communities back on their feet. When disaster strikes, people often requiere food relief. However, this must also be accompanied by agrifood sector relief with the aim to help people transition from humanitarian assistance to becoming self-reliant.

Adopting a recovery, rehabilitation and reconstruction approach towards resilient agrifood systems. Such an approach is not only about regaining what was lost, but about "building back better" with the objective of tackling the root causes of vulnerability leading to loss and damage and enhancing the resilience of agrifood systems to reduce future risks. Actions in these phases can be introduced by using a value chain approach, including upgrading and modernizing farming and fishing practices, introducing climate-resilient techniques, and investing in better infrastructure.

Finally, the aim of this report is to stimulate discussions on the central role of agrifood systems in the loss and damage debate and at to identify the actions that can be taken to start addressing gaps in data, knowledge and finance. All these actions will ensure that agrifood systems can support better production, better nutrition, a better environment and better lives, leaving no one behind.

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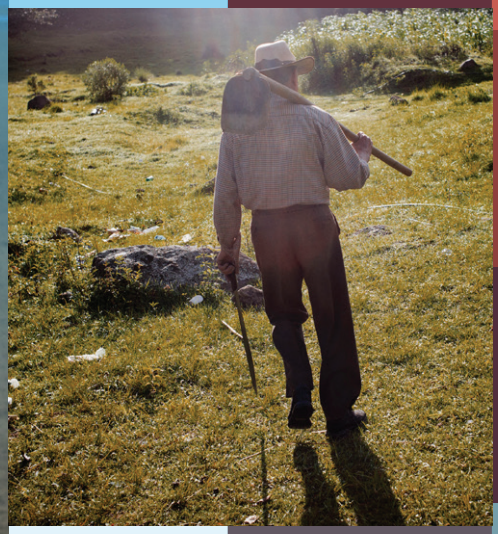

Agrifood systems are intrinsically linked to climate change and are particularly vulnerable to its impacts. Each year hundreds of billions of dollars' worth of crops and livestock production is lost due to disaster events, undermining hard-won development gains and livelihoods for farmers. At the same time, agrifood systems are substantial contributors of emissions. As such, agrifood systems must play a central role in providing solutions for climate change – both adaptation and mitigation – while meeting the food security needs of present and future generations.

The communities that support and depend on agrifood systems are on the front line of loss and damage associated with climate change. Loss and damage can generally be described as the negative impact of climate change that occurs despite mitigation and adaptation efforts. Addressing loss and damage in the agrifood system is crucial, given its importance for livelihoods and sustainable development. Taking collective action is essential to tackle loss and damage in agrifood systems to ensure that the livelihoods of the most vulnerable communities are adequately protected and food security needs are met.

The purpose of this report is to stimulate discussions on the central role of agrifood systems in the loss and damage debate and identify the gaps in data, knowledge and finance that need to be addressed. The report provides an overview of the loss and damage concept, the status of analytical methodologies and tools, a summary of the reporting on loss and damage in Nationally Determined Contributions (NDCs), an outline of the policy needs and some preliminary analysis of the financing needs. Overall, support to countries needs to be targeted and strengthened so that loss and damage in agrifood systems can be dealt with as early as possible. This support needs to ensure that no one is left behind while striving for better production, better nutrition, a better environment and a better life.

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